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A TEXTBOOK OF ORTHOPÆDIC NURSING

EVELYN G. PEARCE

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BY

EVELYN C. PEARCE

Certificated, *Orthopædic Nursing*, Baschurch; *General Nursing*, Royal Southern Hospital, Liverpool; Teacher's Certificate, Chartered Society of Massage and Medical Gymnastics; Sister Tutor, Fazakerley Hospitals and Sanatorium; *formerly* Sister Tutor and Teacher of Medical Gymnastics, the Shropshire Orthopædic Hospital and Agnes Hunt Surgical Home, Oswestry

WITH A FOREWORD BY

SIR ROBERT JONES, BART.
K.B.E., C.B., F.R.C.S.

AND AN INTRODUCTORY CHAPTER BY

DAME AGNES HUNT, D.B.E., R.R.C.

Founder and Honorary Superintendent, the Shropshire Orthopædic Hospital and Agnes Hunt Surgical Home, Oswestry

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Foreword

By Sir Robert Jones, Bart., K.B.E., C.B., F.R.C.S.

This little book should be read not only by every nurse, but also by all voluntary helpers interested in child welfare. The author has spent many years in the training of students as orthopædic nurses, and has proved an unusually distinguished and successful teacher. She has not only the faculty of imparting knowledge by the written word, but also the still greater gift of stimulating the habit of accurate observation. The orthopædic nurse has come to stay, and will always prove a great acquisition to any hospital or institution or clinic which deals with the adult cripple or the crippled child. Her education has been on special lines. Not only must she know her anatomy and physiology, but she must also be expert in her knowledge of the working of splints and the application of even complicated plaster supports. She must have a practical working knowledge of physiotherapy in its various branches, and must be able to teach the patients with whom she comes in contact the laws of hygiene as they apply to the preventive aspect of deformity. The information Miss Pearce has conveyed to us is, I consider, of the highest value to all who take an interest in deformity and injury, and I wish her book every success.

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Author's Preface

The object of this book is to help nurses in training in the general hospitals of the country to a better understanding of the treatment of orthopædic cases and consequently to a deeper interest in this branch of surgical nursing.

The nursing of orthopædic cases is essentially a practical subject, and one that cannot be learned entirely from a book. Any treatments that are described in these pages are of necessity described in a very general way, as in orthopædic nursing, even more than in other branches of nursing, no two cases are alike and each case requires individual treatment.

The readers are fortunate in the addition to the book of a chapter by Dame Agnes Hunt, R.R.C., the pioneer of orthopædic nursing. I am indebted to Dame Agnes for anything of value the book may contain : any knowledge I have been able to pass on to others was given me by her ; it is to ' Sister Hunt ' I owe it all. I also thank her for many valuable suggestions in the correction of the proof sheets and for lending photographs for use as illustrations.

My thanks are also due to Mr. T. P. McMurray and to the Alder Hey Children's Hospital (West Derby Union), Liverpool, for lending photographs ; to Messrs. J. Critchley & Sons for photographs and blocks ; and to Miss L. Wastall Jones for her untiring help during the compilation of the manuscript.

1927. E. C. P.

Introductory Chapter

By Dame Agnes Hunt, D.B.E., R.R.C.

Founder of the Shropshire Orthopædic Hospital and Agnes Hunt Surgical Home

To the Orthopædic Nurses of the Present and Future

I have been given the privilege of writing the first chapter of the first textbook on Orthopædic Nursing that has ever been written. I am going to do my poor best to put the high ideals of your profession before you.

First, then, the triple object of Orthopædic work is Prevention, Treatment, and Training. Of these Prevention undoubtedly stands first. You will perhaps ask, 'But what can we do to prevent crippling diseases? Our work is to carry out the Orthopædic Surgeon's orders.'

Quite so, and I hope you will do it well, for that is the obvious part of your training. What perhaps is not quite so obvious to you is that during the whole of your training you are being taught the great laws of health, i.e., the value of pure air, sunlight, pure water, good sanitation, proper exercise and food, cleanliness, and orderliness,—and the psychological aspect of your training,—obedience, observation and control.

What use are you going to make of this training? Are you going to be content with the dreary round of straightening and keeping straight the various patients

committed to your care in your orthopædic centre ? Or are you going to join actively in the great campaign of Prevention ? Are you going to be a teacher and apostle of Prevention, or are you going to be a hack, blindly carrying out the orders of your profession without reason or initiative ?

All orthopædic nurses should realize that the great majority of cripples are made cripples by the violation of some law of health : they are not born cripples.

Let us take the three great crippling diseases of this land of ours—Tuberculosis, Rickets and Poliomyelitis. These three diseases are responsible for the vast majority of cripples. The methods of the prevention of the first two are known : the way to prevent Poliomyelitis we do not know, except that it would be less likely to occur if it were possible for everyone to observe and carry out the laws of health.

With regard to Tuberculosis, we know that the two great causes of this terrible disease are human contact and tubercular milk. It seems incredible that human beings may be clever enough to find out the causes of a disease and how it is spread, and yet are so unreasonably stupid as to go on for long years after the discovery meekly seeing their dear ones stricken down by this same disease.

Probably the reason is that prevention is difficult, and entails a great deal of trouble. Also in tuberculosis the results of contact may be long delayed, and people do not connect cause and effect. It is so much easier to say 'Stuff and nonsense ! I don't believe in these new-fangled notions,' and so the children suffer because of these doubting Thomases.

With regard to the milk, it is much the same. It is more trouble and probably more expensive to get ' Grade A ' milk, and ' After all, my dear, Mrs. So-and-So always

gets her milk from next door, and none of her children have got anything the matter with them.'

Now it is up to you to explain to the mothers of England why Mrs. So-and-So's children do not contract the disease, and why somebody else's children exposed to exactly the same conditions do. You have all learnt in your training the theory of Asepsis. You have all been told what may be the result in an operation if you are careless and unconscientious, and you all know how often the results of such carelessness do not lead to the dire results which you have been taught may follow. You have also been taught the reason of this failure, namely, the natural resistance of the individual patient to the particular germ which through your carelessness may have been introduced into the operation wound. Teach the mothers that though this may happen in twenty cases, yet the twenty-first may die as a result of your carelessness. Teach them the germ theory in simple terms : teach them that these alien and dangerous germs must be kept out of their children's bodies lest peradventure they may obtain a grip which the phagocytes, the policemen of the body, are not strong enough to destroy.

Make the mother realize the incessant unseen war that is going on between the child's resistance, which is Nature's last defence, and the various death-dealing microbes in our midst.

Get her to envisage this unseen world, and you will have no difficulty in getting her to take such necessary precautions as you may think desirable. But you must think out a reasonable plan that is possible for the mother to carry out, and you must, if possible, get help for her, remembering that in such cases an ounce of help is worth a pound of advice.

The second preventable disease, Rickets, is due to the

lack of proper food and sunshine. It is a disease of malnutrition. I want you all to remember that Rickets not only affects the bones, but it also affects the general health. It is thought that the throat and lungs are affected first, and that the bronchitis of teething is due to this condition. One thing is certain—that rickety children almost invariably suffer from adenoids and enlarged tonsils.

Recent experiments appear to point to the fact that Rickets is due to a want of Vitamin D. This vitamin is contained in sunshine, milk and butter during the summer months, in eggs, and especially in cod liver oil. If a pregnant mother gets plenty of sunshine, her blood becomes charged with Vitamin D, and this vitamin is conveyed through the mother's blood to the child during the months of pregnancy, with the result that when the child is born it has a store of Vitamin D for use. This is Nature's line of defence against this disease. If, however, the mother cannot get out for any reason, or if it is winter time, she will do well to eat one or two eggs daily. If, as is probable, eggs are too dear, then very small quantities of cod liver oil should be taken, and this can usually be got at a Child Welfare Centre. The worst of cod liver oil is its nasty taste, but this can be obviated by the addition of a little orange or cowslip wine. Anyway, few mothers will refuse to take it, if you can persuade them that it is necessary for the health of their offspring, though they may heartily concur in the sentiments of the lady of fifty years old, who, on hearing of this added horror of pregnancy, piously remarked, 'Thank God I'm a grandmother.'

Milk is a very necessary food for young children because of the calcium it contains, and also because of the growth vitamin (Vitamin A) in the cream. All infants should be lightly clothed and exposed as much

as possible to the rays of the sun. An infant, even if only a week old, can take and digest half a teaspoon of cod liver oil, and this may be necessary in those cases born in the winter or in towns where the smoke is so bad as to obscure the ultra-violet rays of the sun. Remember, cod liver oil is best given unmixed with maltine or other emulsion because of the difficulty of ascertaining the amount of cod liver oil the child is really getting.

One word I should like to say on the general bringing up of children. Try to make the mother understand that a child once weaned requires quite a lot of water to drink ; that they must get their children into regular habits, insisting on their having their bowels open at the same time every day, and regulating these daily evacuations by means of fruit and not by means of aperient medicines. Try to make them understand how pernicious is the custom of a weekly aperient : let them spring-clean their bodies every Saturday night by all means, but do not let them spring-clean their poor little insides. Impress on the mothers that when a child has got a scratch or cut that Nature's line of defence has been injured, and that she should paint the wound with iodine or methylated spirit, and then cover it up with a scorched rag. Explain to the mother that margarine and bread is not a good diet for children, and that the butter in the household should be reserved for the children. Think out cheap variations of food that children can take to school with them, remembering that a child's breakfast is usually at 8 a.m., and that, except for what it takes to school, the next meal is at 5 or 6 p.m.

Try to get the mothers to teach their children obedience, because in so doing she will strengthen their character and control. If she can once teach her child that her

'No' is really meant and has a reason behind it, she will find that the management of her children and home is a very easy matter. Explain to her that to slap her child because she herself is frightened or in a bad temper is not 'cricket'.

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Chapter 1

SOME POINTS ON ANATOMY AND APPLIED ANATOMY

Normal Curves of the Body

The word 'orthopædic' is derived from two Greek words meaning 'the rearing of straight children'.

A knowledge of the normal curves of the body, the normal movements of the joints of the body, and the action of the skeletal muscles in groups, is essential to the student of orthopædic nursing. The nurse would do well before beginning the study of orthopædic nursing to revise her knowledge of anatomy on the lines suggested in this chapter.

A careful study of the curves of the skeleton should be made, comparing these with the curves of the body of a normal child. Note particularly the antero-posterior curves of the vertebral column, the inclination of the pelvis. Note, in the lower extremity, the angle of the femoral neck; the outward bowing of the shaft of the femur in its upper part; the forward bowing strengthened behind by the linea aspera; the inward inclination of the internal condyle of the femur; the outward bowing of the shaft of the tibia, and its less definite forward curve. Any of these normal curves may become exaggerated when the bones are soft, thus producing some of the deformities seen in rickets.

The student will remember that the concavities of the curves frequently serve for the protection of the more

delicate structures: she should now realize the importance of the convexities of the curves, which in many instances serve as arches transmitting the weight of the body from one to another.

Limitation of Joint Movement

In reviewing the joints of the skeleton, the points to be specially noted are the degree of movement of which each joint is capable, and the normal limitation of these movements. Limitation of joint movement may be considered under four heads: (*a*) that due to the shape of the bones entering into the formation of the joint; (*b*) restraint due to ligamentous attachments; (*c*) resistance offered by muscular contractions; (*d*) contact of the part moved with other parts of the body.

Muscular Action on Joints

The elastic property of muscle plays a very considerable part in maintaining joint stability: it is important for the nurse to remember this. For example, a pathological dislocation may be produced at the humero-scapular joint, in a case of infantile paralysis affecting the muscles controlling this joint, by even the slightest ungentle handling (see page 41), whereas the same condition is sometimes produced at the hip joint by the spastic contractions of the adductor muscles in cases of spastic paraplegia.

The skeletal muscles are *voluntary* muscles, but many movements are performed either as the result of habit or associated with other movements. A person walking may be conscious of moving the limb forward but oblivious of the fact that flexion and extension is taking place at the knee and ankle joints, abduction at the hip-joint opposite to the moving leg, rotation of both

pelvis and shoulders, combined with side bending of the trunk. Once the orthopædic nurse realizes the dependence of the equilibrium and balance of the whole body upon any portion of its musculature, she will see the necessity of frequent and careful examination of her patients. In dealing with new cases, she should not be satisfied with examination only of the part the patient brings to her notice; a complete examination of the whole body should always be made, similar to that described on page 123. A detailed knowledge of the skeletal muscles is not essential, although it is a useful asset; but a knowledge of the working of muscles in groups is necessary, and the following brief outline may prove helpful :—

The Ankle Joint. Movement takes place mainly in two directions: (1) bending or dorsi-flexion performed by the dorsi flexors of the ankle or the anterior tibial group of muscles (tibialis anticus and the extensors of the toes), and (2) straightening or plantar flexion by the plantar flexors or the posterior tibial group (the muscles entering into the formation of the tendon of Achilles, and some deeper muscles, the tibialis posticus, and the long flexors of the toes).

Anatomists differ regarding the terminology used to describe movements of the ankle joint: for all practical purposes it is sufficient if the nurse realizes that a bending or doubling up is called flexion, and a straightening out is called extension, and that, in this instance, the muscles which extend the toes help to flex or dorsi-flex the ankle, and those which flex the toes help to extend or plantar-flex the ankle.

The Medio-tarsal Joints. These are the joints between the os calcis and the cuboid on the outer side of the foot,

and the head of the astragalus and the scaphoid on the inner side: the movements of eversion and inversion occur at these joints, combined with movements of abduction and adduction at the sub-astragaloid joint, that is, the joint between the astragalus above and the os calcis below.

Eversion, or raising the outer border of the foot, is performed by the peronei muscles, a group of three, extending from the fibula to the outer side of the foot. The tendons of two of these can be felt behind the external malleolus: the tendon of one—the peroneus longus—extends across the sole of the foot. Inversion, or a turning up of the inner border of the foot, is performed by two muscles: one from the anterior tibial group—tibialis anticus—and one from the posterior tibial group—tibialis posticus: the latter has several attachments to the bones in the sole of the foot.

The Knee Joint. This joint is formed by the lower extremity of the femur and the upper extremity of the tibia, held together by ligaments, with which the muscles moving the joint are intimately connected in the formation of a capsule of the joint, and upon which the stability of the joint very materially depends. Movement takes place in two directions, flexion and extension. Lateral movement of the tibia on the femur can be obtained when the knee joint is flexed, but in extension the joint is stable: any instability in this position is abnormal and due to laxity in the ligaments of the joint (see page 83).

Flexion is performed by the ham-strings, a group of three muscles which extend from the tuberosity of the ischium down the back of the thigh, two to be attached to the upper extremity of the tibia on the inner side, and one to the upper extremity of the fibula on the outer

side of the joint : also by some of the muscles forming the calf, mainly the gastrocnemius. Extension is performed by the anterior thigh muscles, a group of four, the quadricips extensor, in the tendon of which the patella is formed ; the two lateral muscles of the group extend well down on each side of the patella, forming the lateral patellar ligaments.

The Hip Joint. In the formation of this joint, which is surrounded by strong ligaments, the head of the femur is received into the acetabulum of the innominate bone. The ilio-femoral ligament in front of the joint limits extension, and, in the absence of muscular action, helps to maintain the erect position. The movements of the hip joint are very extensive, consisting of flexion, extension, adduction, abduction, internal and external rotation. The muscles acting on the joint are numerous.

Extension of the joint is produced mainly by the gluteus maximus, a powerful muscle forming the buttock : flexion, by the muscles in front of the joint, iliopsoas, rectus femoris, gracilis, and sartorius. The latter also abducts and externally rotates the thigh. Tensor fascia femoris is a muscle in front of the joint, which, in cases of infantile paralysis, is frequently unaffected, and, in cases where the patient has been allowed to sit a great deal, becomes contracted, producing flexional deformity of the hip joint (see illustration, page 58). Adduction is performed by a group of muscles on the inner side of the joint, frequently called the adductors : these muscles also help to flex the joint and rotate it externally ; in cases where they are contracted, the deformities of adduction, flexion, and external rotation of the thigh are present. Abduction is performed mainly by the gluteus medius and the gluteus minimus, two muscles situated to the outer side of the joint.

The Shoulder Joint. The shoulder joint is of the same type as the hip joint, but varies from it in the shallowness of the joint surfaces and the looseness of its capsular ligament, both of which permit great freedom of movement.

Flexion of the arm is performed mainly by the pectoralis major and the anterior part of the deltoid ; extension, by the teres major, latissmus dorsi, and the posterior fibres of the deltoid ; abduction, as far as slightly less than to right angles with the trunk, by the deltoid, elevation above this being obtained by the muscles moving the scapula ; adduction is obtained mainly by gravity.

The movement of the scapula on the wall of the chest is very considerable, and greatly assists the mobility of the arm. In cases where arthrodesis of the humero-scapular joint has been performed, this mobility is invaluable, and in the post-operative treatment of these cases the nurse will be required to concentrate on obtaining elevation of the scapula by the trapezius and the carrying of it forward by the serratus magnus. Paralysis of this muscle will produce winging of the scapula.

The Elbow Joint. The elbow joint is formed between the trochlear surface of the lower extremity of the humerus and the greater sigmoid cavity of the upper extremity of the ulnar : it is a hinged joint permitting of movement in two directions, flexion and extension. Flexion is performed by the brachialis anticus which passes directly over the front of the joint, assisted by the biceps, the supinator longus, and by the muscles attached to the internal epicondyle of the humerus (the superficial flexor group). Extension is performed by the triceps, anconeus, and by the muscles attached to the external epicondyle of the humerus.

The radius is carried with the ulna in the movements

of the elbow, and, with the ulna, forms the radio-ulnar joints, in which the radius rotates on the ulna in the movements of pronation and supination. When the forearm is pronated, the palm of the hand faces downwards ; and when the forearm is supinated, the palm of the hand faces upwards. These movements, to be pure, should be performed with the elbow flexed at right angles ; otherwise rotation of the humerus at the shoulder joint will occur.

The Wrist Joint. The wrist joint and the joints of the carpus act together. Flexion is freer than extension, and is performed by the flexor carpi-radialis, the flexor carpi-ulnaris, and the palmaris longus. Extension is more limited, and is performed by the extensor carpi-radialis longior and brevior. Adduction or deviation of the hand to the ulna side is performed by the extensor carpi-ulnaris and the flexor carpi-ulnaris. Abduction or deviation of the hand to the radial side by the extensors of the thumb, the extensor carpi-radialis longior and brevior and the extensor carpi-ulnaris. The flexors and extensors of the fingers also act on the wrist in certain positions of the hand.

The Joints of the Hand. The thumb is capable of very free movement owing to the shape of the articulating surfaces of its carpo-metacarpal joint ; the movements taking place here are abduction and adduction, flexion and extension, circumduction, and opposition of the thumb to the fingers. The nurse should become familiar with these movements by studying them on her own hand. The thenar eminence is the pad of muscle at the base of the thumb, made up of muscles which adduct, oppose, and help to flex and abduct it. The hypothenar eminence is the pad of muscle on the ulnar

side of the palm, consisting of muscles which act on the little finger.

The metacarpo-phalangeal joints are condyloid joints, permitting the movements of flexion and extension, adduction and abduction (the two last are performed by small muscles in the palm of the hand) ; wasting of these is shown by hollows between the metacarpal bones on the back of the hand.

The interphalangeal joints are hinge joints permitting of flexion and extension only. In examining the movements of finger flexion the nurse should see that each joint can be separately moved (as different muscles act on each joint) : this is best done by supporting the finger below the joint to be moved.

Chapter 2

CONGENITAL CLUB FOOT; CONGENITAL DISLOCATION OF THE HIP JOINT; TORTICOLLIS

Congenital Club Foot or talipes equino-varus. In this condition the foot is turned inwards and slightly plantar flexed, the sole very concave in shape, the heel often small and badly formed. The shape of the bones of the foot is not altered, but the position of the bones in relation to each other is abnormal. In a baby's foot the bones are represented by cartilage which is soft and will yield easily to pressure.

In cases untreated in early childhood the bones become altered in shape, especially when weight has been borne upon them in walking, and the deformity becomes more fixed. The soft structures adapt themselves to the altered position of the bones: the muscles plantar-flexing and inverting the foot become shortened, and the plantar fascia contracted; the muscles everting and dorsi-flexing the foot become stretched and weakened. Callosities appear on the part of the foot subject to pressure in walking, and are sometimes very painful: disuse of the muscles controlling the foot at the ankle joint gives the leg a wasted appearance. Secondary deformities may also occur, either internal rotation of the tibia at the knee or knock knee, but these are more often seen in cases that have undergone treatment.

The treatment varies according to the age at which the

patient comes under the observation of a surgeon. Club foot in a baby is a simple twisting of the foot, and may be treated by manipulations to correct the deformity, and be maintained in the correct position by strapping or plaster of Paris. When the deformity is noticed at birth, the nurse in attendance should manipulate the foot whenever she attends to the baby, by taking hold of the foot at the ankle, and, while steadying it with the palm of

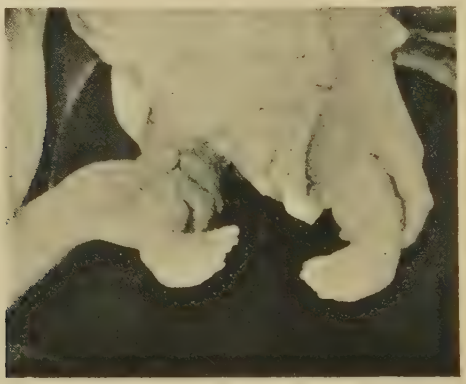

FIG. I.
Congenital Club Foot (Front View).

the hand on the outer side of the heel, straightening the front part of the foot.

After a few days strapping may be put on when the foot has been straightened. Apply by taking a strip of adhesive plaster about one inch in width, fastening one end on the dorsum of the foot, straightening the foot, and carrying the strapping beneath the sole and up on the outer side of the leg: then, flexing the knee, take the strapping above the knee and across to the inner side of the leg. A second shorter strip, taken round the

leg below the knee over the strips going up on the outer side and down on the inner side, may prevent these from slipping. The strapping may be covered by a bandage applied in the same way ; this can be more easily removed if wet or soiled. Strapping may require renewal either daily or every two or three days, according to the resistance of the structures, the aim being to maintain correction. The strapping may irritate the skin, and great

FIG. II.
Congenital Club Foot (Back View).

care should be taken (*a*) to remove strapping that has become wet, (*b*) to avoid creases, and (*c*) to keep the surrounding skin clean and dry.

Plaster of Paris may be used in cases where the intelligent co-operation of parents is not available ; apart from these cases plaster of Paris is not ideal treatment in babies under twelve months old. In applying plaster of Paris the limb should be covered by some soft material such as wool or stockinette before the plaster bandages are put

on. These bandages are applied in the same direction as that described for the application of strapping, and should always be carried above the knee ; otherwise the leg may move in the plaster, and correction will not be maintained. The foot is over-corrected and held in position until the plaster sets : here also creases must be avoided, and, for this reason, as much correction as possible should be obtained before applying the plaster. The plaster will require renewal from time to time ; wearing an old sock over it will prevent injury to the other leg and also help to keep the plaster clean.

In cases where a very small heel is seen, the surgeon may tenotomize the tight structures at the back of the ankle and force the os calcis down to its correct position before the plaster is applied. These corrective measures will be employed until the foot does not revert to the original position of deformity when the support is removed. As soon as the child is old enough, he should be taught to hold the foot in the correct position for a few minutes at a time, until full power returns and the foot can be controlled with ease. Re-education is an important part of the treatment ; dorsi-flexion and eversion should be taught, the movements being assisted at first, then free, and later performed against resistance. This treatment should be continued until the child begins to walk, even when the deformity is apparently corrected. Walking requires supervision ; a shoe with a broad flat heel will be ordered, with in some cases the sole of the shoe raised on the outer side in addition, in order to deflect the weight on to the inner side of the sole of the foot. The nurse should make careful observation of any alteration in the shape of the shoe and of the way it is worn out. These observations should be continued during the child's growing years.

When a child walks on a deformed foot, the deformity

becomes fixed, and cases that have been neglected generally require operative treatment. In cases where correction can be made by wrenching the foot under a general anæsthetic, the surgeon may require a wooden block which the nurse should pad. For a very small child he may prefer to use a firmly rolled calico bandage as a fulcrum over which to stretch the foot. When the deformity of the front of the foot has been corrected, the tight structures at the back are stretched next; and, if necessary, the tendon of Achilles is lengthened by subcutaneous division. When the whole of the structures have been stretched, and the foot can be corrected with-

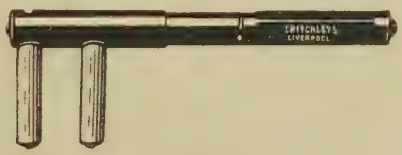

FIG. III.

Thomas's Club Foot Wrench.

out force, plaster of Paris is applied and the foot maintained in over-correction. The child may have pain for twenty-four or thirty-six hours owing to the stretching of the tight structures. It is important to make observations of the toes for circulatory changes, which would occur if a strand of bandage had been too tightly applied. Beyond this, nursing consists in the care of a case after general anæsthesia, and the application of plaster of Paris.

After a few days the child will be allowed to walk in plaster with the foot in this position, in the original plaster, if strong enough, or a fresh one may be applied, strengthened for walking purposes (this is called a walking plaster). An old stocking is worn over the

plaster to keep the toes warm and clean, and an old boot, cut down the front to the toe-cap, is worn to protect the plaster (commonly called a plaster boot). Constant observation of the plaster for softening or breakage is always necessary, and of the knee for knock knee, as, the plaster being heavier than ordinary foot wear, the thigh muscles may tire, with resulting laxity of the ligaments at the knee joint. Correction in plaster will be maintained for several months, after which re-education and observation in walking will be carried out as described before. In all cases of corrected club foot, re-education of the movements of dorsi-flexion and eversion should be maintained until they can be performed against resistance.

A splint to maintain correction should be worn at night for a longer or shorter period according to the persistence of the tendency to revert to the original deformity during sleep. The child should be kept in touch with some hospital or after-care centre until the growing period is over.

Neglected cases of congenital club foot, untreated until adolescence, or even until adult life is reached, may require operation for the removal of bone in the correction of deformity. The after-treatment of splinting, and re-education, will be similar to that just described, except that a longer period of rest will be necessary.

Congenital Dislocation of the Hip Joint

Congenital Dislocation of the Hip Joint may be bi-lateral or uni-lateral, and the head displaced either forwards or backwards, lying on the dorsal surface of the ilium (the commonest position). The changes found are a rudimentary acetabulum, the capsule of the joint lengthened, the ligamentum teres atrophied ; a secondary acetabulum

is found where the head of the femur rests on the ilium as the result of continued pressure ; the head is small and ill formed.

There is exaggeration of the lumbar lordosis ; the patient walks with a limp due to absence of stability at the hip joint ; the body inclines to the affected side when weight is transferred to that side. The limp is more noticeable in uni-lateral than in bi-lateral cases,—in the latter, the patient waddles along, rolling from side to side ; the gluteal muscles are wasted ; the buttocks look flat, and the curve is not as well marked as in the normal, the outline of the curve being obliterated ; the limb is short, and the great trochanter will be found to be above Nélaton's line (see page 86) ; the pelvis looks broader than normal, the width being due to the abnormal position of the femoral heads.

Examination of the movements of the hip joint will probably reveal that abduction is limited. In a young child unnatural mobility may be found with telescoping of the femur on the ilium. To ascertain this, with the child lying on his back, flex the thigh of the affected side to right angles with the trunk ; grasp the thigh above the knee, and place the other hand behind the hip joint. Then alternately draw the femur away from the pelvis, and press it towards the pelvis, when, in a posterior dislocation, the head of the femur will be felt against the palm of the hand behind the buttock,—the result of a telescoping of the femur, which could not be obtained were the head in the acetabulum. The head of the femur cannot be felt in its normal position in the groin, and if an attempt be made to flex, abduct, and rotate the femur externally, the head will not become prominent here as it should do. The long posterior thigh muscles are shortened, probably because of the short distance between their pelvic attachments and the attachments at

the knee; the muscles passing between the pelvis and the great trochanter are lengthened and wasted.

In older children the limb may be flexed and abducted with shortening of these muscles in addition. Such chil-

FIG. IV.

X-ray photograph of Congenital Dislocation of Right Hip Joint.

dren may complain of being easily tired, and untreated cases later in life may be very greatly inconvenienced by this fatigue, and pain may also occur. An X-ray photo-

graph will be taken to confirm the diagnosis, ascertain the position in which the head of the femur is lying, and determine the condition of the bones.

The treatment in young children is reduction of the dislocation and replacement of the femoral head into the acetabulum, with fixation in plaster of Paris, until the parts have become adapted to their new position. The success of the operation depends largely on the depth of the acetabulum.

Reduction is performed usually by the 'Lorenz' operation or some modification of it. The procedure is as follows: With the patient anæsthetized, manipulations to lengthen the shortened structures, particularly the adductors and the hamstrings, are performed by movements of the thigh in abduction and extension. With the knee extended, flexion of the thigh is also performed, to stretch the last-named muscles. An assistant steadies the pelvis by holding it and the opposite thigh; the nurse must be prepared to do this, and must therefore be familiar with the procedure, so that she may know what movements the surgeon will make, and, by her steady holding of the pelvis, facilitate the necessary stretching. Subcutaneous division of the adductor muscles is sometimes necessary. The surgeon will then reduce the dislocation and fix the pelvis in plaster, with the thigh abducted and externally rotated, the head of the femur being well forward.

The surgeon may decide to apply the plaster, the nurse holding the limb, whilst a second nurse steadies the other leg. In holding the limb, the nurse will stand at the side, holding it steadily in position, and, by slight pressure on the femur, make sure that the head is kept well pressed forwards. If the surgeon prefers to hold the limb, whilst the nurse applies the plaster (see Appendix, page 133), she must endeavour to get great firmness and

FIG. V.
Case of double Congenital Dislocation of the Hip Joint, showing marked lordosis.

support behind the head of the femur, by even pressure, upwards and forwards, with a firm smooth stroke of the hand after each layer of bandage is applied, with the object of supporting the femoral head. The knee may or may not be included in the plaster; if it is, the nurse will probably be told to hold it in a position of flexion. The ordinary nursing care necessary after an anæsthetic will be taken; if the manipulations were extensive and prolonged considerable shock may be expected, though this is rare. The buttocks should be supported on a pillow, and, in cases where the feet are not included in the plaster, these should be wrapped in warm wool and supported to avoid swelling. In young children great care will be needed to prevent the soiling of the plaster by excreta; oiled silk placed round the edges of the plaster will assist, and the child should be held out to pass urine as often as is found necessary.

This first position will be maintained from two to six months; the surgeon may then alter the position and apply a fresh plaster, maintaining the limb in less abduction, flexion, and external rotation. In the second position the patient may be allowed to bear weight by standing and walking if the position permits of this. After a variable further period of about six to eight months (the length of time depends on the condition of the joint), the surgeon may order the plaster to be cut down and massage and exercises to be done. As the position of the limb will be one of abduction and external rotation, active movements should be used to obtain adduction and internal rotation, advancing the treatment by gently assisting the movements. Passive movements should not be employed, except in the direction of abduction and extension. After a few weeks of this treatment, during which the patient may be lying in bed, with or without the plaster, aim at teaching adduction

and internal rotation of the thighs by gentle rolling movements ; then, allowing him to sit up, repeat these movements, progressing until an object can be gripped between the knees. Walking should be taught as a baby learns, by support from behind, gradually allowing the child to feel its weight, and always obtaining internal rotation and adduction at the hip joints, instructing the child to point the toes forward. From the same position teach leg swinging, allowing weight to be borne by degrees on the affected limb or limbs, and the leg-swinging to consist as far as possible of internal rotation and adduction only. Walking without support should only be permitted when a nurse can teach and observe it, beginning by short steps with the foot carefully directed forwards, placing the feet on marks made on the floor : these marks may take the form of stepping-stones, railway lines, or anything that will appeal to the imagination and stimulate interest and perseverance. Stepping over small articles will teach and assist balance. The nurse should see that internal rotation is performed at the hip joint, and not by rotating the pelvis forwards, bringing the thigh with it, or by twisting the foot at the mid-tarsal joint to get the toes pointed forward without rotating the thigh. A child, wishing to please by pointing the toes in the direction indicated, may make either or both of these mistakes, unless carefully watched. This period of re-education usually occupies several months.

In some cases, secure fixation of the head of the femur in the acetabulum cannot be maintained, and an anterior re-position of the head may result ; as a rule the surgeon decides to be satisfied with this, as the functional result is often quite good. Re-education will be performed as in other cases, with the addition that passive movements are permissible from the first.

Torticollis

Torticollis or wry neck is a twisting of the neck. It may be due to malposition in utero ; it is sometimes thought to be caused by injury at birth, due to rupture of some of the muscle fibres, which later produces a fibrous contraction.

The condition may also be acquired, and in children may be due to irritation from inflamed cervical lymphatic glands or other painful conditions of the neck. In these cases the symptoms are acute, with pain, rigidity, and sometimes fever. In adults rheumatism or injury are commoner causes.

The congenital type is a painless contraction, usually of the sterno-mastoid muscle. The head is slightly flexed and drawn to the side of the contraction ; the face rotated to the opposite side ; and the chin raised and tilted towards the opposite shoulder. In some cases, more especially in those of acquired torticollis, fibres of the trapezius are also affected, and the head may then be extended instead of flexed. There is usually some asymmetry of the face, it being smaller on the side of the contraction. The position of the head makes the eye on the affected side appear lower than on the opposite side. The condition frequently passes unnoticed until the child is a few years of age.

Compensatory deformities occur in untreated cases, flexion of the head producing round shoulders. Side flexion of the head gives rise to scoliosis, either with the primary curve opposite to the side of the contraction and a secondary curve in the dorsal region to that side, or with a cervico-dorsal curve developing on the side opposite to the contraction, and probably a secondary curve occurring lower down the spinal column.

The treatment of congenital torticollis, if slight and if

noticed early, may be correction by manipulation, and the prevention of further contraction by adopting positions opposed to the deformity. The following mani

FIG. VI.

Torticollis due to Contraction of the Right Sterno-Mastoid Muscle.

pulations are performed to stretch the muscles. As the child lies, one person fixes the shoulders, a second corrects the position of the head, by carrying it in the opposite direction to that in which it lies, side-flexing it to the side opposite to the contraction, and rotating it so that the chin points to the shoulder of the affected side. Gently passing the fingers along the muscle will help to stretch it. This manipulation should be performed several times a day, a good rule being to do it every time the child is taken up for changing. Careful attention should be given to the position in which the head lies when the child is nursed and when lying in his cot, and correction should be made frequently. If these measures do not cure, they will greatly assist by preventing the condition from getting worse, and should be persevered with until the child is older, when operative treatment may be considered.

Division of the sternal end of the sterno-mastoid by the open method is the operation usually employed, combined with stretching and fixation in plaster of Paris in a position of over-correction. The over-correction is maintained by sandbags for the first thirty-six to forty-eight hours after the operation, until the likelihood of post-anæsthetic vomiting is over ; then the head is put up in plaster of Paris. The amount of over-correction adopted is very marked, so that the patient in plaster appears to have a torticollis to the opposite side.

After a period of about six weeks the plaster will be cut and re-education begun. The nurse should see that, when the plaster is off, the patient can voluntarily over-correct the head into the position it occupied whilst in plaster. This voluntary control is most essential, and patients should be taught to perform over-correction frequently. A simple guide is to see that the head, when over-corrected, is held so that the eyes do not appear

level, but the eye on the side of the original contraction is elevated above the other when the head is side flexed and rotated; thus an effect is produced opposite to that of the original deformity. A plaster support should be worn at night until good voluntary control is obtained.

The success of the treatment depends largely upon the careful maintaining of the over-correction obtained at the operation. Training and re-education are particularly necessary after the plaster is removed, with constant observation of the positions of the head adopted during rest.

In cases of paralytic torticollis the contracted muscles are those on the side opposite to the muscles affected which are paralysed; in other words, the contraction in these cases is produced by the unopposed action of unaffected muscles. This condition is sometimes due to infantile paralysis, and the treatment will be on the lines described in the chapter on that subject.

Chapter 3

FLAT FOOT; CLAW FOOT

The Arches of the Foot

The function of the foot is to support the body in standing, and to act as a fulcrum from which it is propelled forward in walking. Normally the bones of the foot are not all in contact with the ground; the parts receiving greatest pressure are the os calcis, the head of the first, and the heads of the fourth and fifth metatarsal bones. The foot may be looked upon as an arched support, the summit being the astragalus, from which the foot receives the weight of the body. The weight is then directed backwards to the os calcis and forwards to the heads of the metatarsus.

Between these points the bones are arranged in a series of arches, which, for convenience and simplicity, are frequently described as two longitudinal and two transverse arches. The internal longitudinal arch is formed from behind forwards by the os calcis, the posterior base; the astragalus, the summit of the arch, the scaphoid, internal cuneiform, and the first and second metatarsal bones, the heads of which form the anterior base. This arch is the most elaborate and the one most commonly depressed. The outer longitudinal arch extends along the outer side of the foot from the os calcis to the fourth and fifth metatarsal bones, and is less elaborate than the internal arch, is nearer the ground, and therefore stronger. The transverse arches extend across the foot, and are divided

into the anterior transverse metartarsal arch, formed between the heads of the metatarsal bones, the first and fifth receiving the greatest pressure and acting as the piers of the arch, and the transverse tarsal arch formed by the arrangement of the tarsal bones. If the foot of a skeleton be examined, it will be seen that the distance across the dorsal surface of the tarsal bones is greater than that of the plantar surface, due to the bones being somewhat wedge-shaped, with the bases of the wedges uppermost.

The anterior transverse metatarsal arch is fairly frequently depressed ; it may be associated with depression of the internal longitudinal arch, or may occur independently of it.

The term ' flat foot ' is as a rule used to describe depression of the internal longitudinal arch. This depression may be slight or severe, congenital or acquired. It may begin gradually with slight inconvenience to the patient, or rapidly and accompanied by acute symptoms.

The following changes occur in the structures. The muscles controlling the foot become weakened, thus straining the ligaments which bind the bones together. The position of the bones is altered, the arch gives, the bones descend, and the whole of the inner side of the foot may be in contact with the ground. This sequence may occur by weakening of the muscles after an illness such as influenza or measles, due partly to the toxæmia and partly to disuse of the muscles whilst in bed ; by adopting bad positions of rest which throw strain on the ligaments ; by walking with the feet turned out, and thus directing the weight on to the weakest part of the arch. On the other hand the bones may become displaced by injury, which will strain the ligaments, and the muscles, being unable to meet the added work, tire and relax.

Acute Flat Foot

Acute flat foot is seen in persons whose work necessitates long hours on the feet in standing or walking. The feet become increasingly painful ; the pain may be described as over the dorsum of the foot, in front of the ankle more to the inner than the outer side. It is due to the dropping of the arch, with alteration of the position of the bones, causing strain on the ligaments. Or it may be experienced on the inner side of the foot, due to pressure of the scaphoid on the spring ligament, which gives way and the scaphoid descends. The muscles of the calf may ache, and gradually the whole leg becomes painful, with swelling of the foot and ankle and local heat.

Complete rest in bed, with massage at the beginning until the acute pain subsides, may be sufficient : after this, special boots, well fitting round the ankle and raised on the inner side, with an elongated heel also raised on the inner side, will probably be required for several months.

In addition to acute flat foot, the condition may be divided into slight cases, where the patient can actively correct the foot ; severe cases, where active correction is not possible but where passive correction can be performed ; and very severe cases, where the deformity is fixed.

The treatment adopted depends on the degree of disability present. In cases where the patient can voluntarily correct the foot, a boot raised on the inner side may be sufficient. If the condition is more advanced, fixation in plaster of Paris for some weeks in the position of inversion may be maintained, followed by the wearing of a crooked shoe and, in some cases, an outside leg iron as well. The patient should be taught to realize the importance of always wearing the boots before putting the feet to the ground.

It is a good plan for the nurse to go carefully over the day's routine as follows. On rising, stockings and boots must be put on before getting out of bed : on returning, they must be taken off after getting into bed. In bathing, the patient should remove the boots last, while seated on the edge of the bath or on a board across the bath ;

FIG. VII.

Flat Foot showing Depression of the Internal Longitudinal Arch.

then, swinging the trunk round and lightly resting the outer borders of the feet on the floor of the bath, lower himself into the water. Children can be lifted in and out ; adults may be advised to let the water run out of the bath, and, after drying the feet, put on the boots before getting out. When a boot and iron is ordered, the

same procedure should be adopted, no weight being borne on the feet without the irons, except during any exercise treatment that may be ordered.

Careful observation of the wearing out of the boots

FIG. VIII.

Outside Irons and Boots raised on the inner side of the Sole, applied in Flat Foot.

must be made, especially of the piece on the inner side, and the degree the surgeon has ordered the boot to be raised must be faithfully maintained. The patient, if an adult, or, in the case of a child, the parent, should be told the degree ordered.

Spasmodic Flat Foot

Spasmodic flat foot is a type of flat foot seen in adolescents. The foot is strongly everted by over-action of the peronei muscles, the tendons of which can be seen and felt in strong contraction. On examination, the foot will be noticed to be held in strong eversion, any effort to reduce this being forcibly resisted.

The treatment ordered may be re-education and passive stretchings of the contracted muscles, although this is of little real value except in very slight cases.

Two operations are performed for this condition: (1) Exsection of the peronei, with full inversion in splints or plaster for from three to six weeks, followed by re-education and the wearing of a boot raised on the inner side, and in very severe cases by an outside iron also; (2) Crushing the musculo-cutaneous nerve as it enters the peronei (Mr. Naughton Dunn's Operation). This ensures paralysis of the muscles which gives the necessary rest. As the bruised nerve recovers, so the function of the muscles returns. The after-treatment of this operation includes special boots and exercises.

Depression of the anterior transverse Metatarsal Arch

The *intrinsic* muscles of the foot help to maintain the mobility of this arch. These may be weakened by either excessive walking or standing, the wearing of high-heeled shoes which throw the weight forward on to the front part of the foot, and by the wearing of very tight shoes, which, by compressing the bones together, prevents movement and causes atrophy of the small muscles of the foot. The heads of one or more metatarsal bones may be displaced downwards, and, pressing on the digital nerves, cause pain (this was described by Dr. Morton of Philadelphia,

and the condition is known as ' Morton's Metatarsalgia '). As the heads of the metatarsals descend, hard skin appears on the sole of the foot ; and if the patient is asked to stand with full weight on the feet, the front of the foot appears wide and flat, and complete depression of the arch is seen.

The treatment is to remove pressure from the metatarsal heads. In slight cases a firm pad of felt or cork is placed in the centre of the sole behind the metatarsal heads and is strapped in position, and the arch is replaced as far as possible. Strapping one inch wide is used ; it is first carried across the dorsum of the foot, which is then compressed from side to side to restore the arch, and the strapping carried round the outer side of the foot, below the sole, across the pad, and up on the inner side. In more advanced cases, a bar, either of leather or rubber, half an inch high, is put across the sole of the shoe behind the position occupied by the metatarsal heads, until pain and tenderness have disappeared, when a metatarsal stud of metal, moulded to support the arch, may be fitted inside the shoe. If the direction of the bar is left to the nurse, she must instruct the shoemaker to place it obliquely across the sole, running from front to back, from the inner to the outer side, as is the direction of the heads of the metatarsus.

Combined with this mechanical treatment, the mobility of the foot and the strength of the muscles controlling it should be increased by voluntary movements, the patient being instructed to ' claw ' with the foot, as if to grasp an object within the sole. Children can be taught to pick things up with the foot, such as a small rubber ball, a piece of sponge, a marble, the exercise being advanced by making the object smaller. The same care with regard to the wearing out of the boot and the avoidance of weight-bearing without the boot, as described in flat foot, must be observed.

In cases too advanced for improvement by these methods, an operation to remove the heads of some of the metatarsal bones may be performed.

Other Deformities of the Feet associated with Flat Foot

Hallux valgus, hallux rigidus, and hammer toe are conditions that may be associated with flat foot.

The term *hallux rigidus* is used to describe a stiffening of the first metatarso-phalangeal joint of the foot ; it may simply be rigid, or it may be deformed in plantar flexion (*hallux flexus*) or with valgoid deformity (*hallux valgus*). In hallux valgus the great toe is outwardly displaced, and may be carried either above or below the other toes. Separation of the surfaces on the inner aspect of the joint can be felt ; and, as this part is subject to pressure from footwear, either bursae or corns or callosities may form upon it. It is to this condition, with prominence of the joint, that the term ' bunion ' is given. Pointed-toed shoes are the commonest cause of this condition. A great deal of discomfort is experienced in these cases both by inflammatory changes in the joint, produced by irritation and pressure, and by inability to use the joint correctly in walking.

Slight cases of hallus valgus are accompanied by a varying degree of rigidity, and these may be relieved by wearing a shoe large enough to permit free movement of the front part of the foot : more severe cases, by wearing a digitated stocking and a peg in the shoe to separate the great toe from the other toes. A splint may be worn at night : a gutter splint with a hole in the centre to avoid pressure over the joint is the one often used ; it is first bandaged firmly to the side of the foot, then the position of the toe is corrected, and it also is bandaged to the splint. In all cases where movement at the joint is possible, the

patient should be taught to perform exercises of the great toe, plantar flexion, dorsi-flexion, abduction, and adduction, the movements being guided by the hand until they can be voluntarily performed.

Very severe cases may require operation. Several operations are performed for this condition, probably the commonest being removal of the head of the first metatarsal bone. The patient is kept in bed for from three to six weeks after the operation according to the degree of tenderness present. On getting up, a transverse horizontal metatarsal bar is frequently ordered (see page 31) until all tenderness has disappeared.

Hammer toe is a condition which may affect any of the toes ; it may be associated with flat foot, with depression of the anterior metatarsal arch, with hallus valgus, or it may be congenital. The first inter-phalangeal joint is dorsi-flexed, and the second plantar-flexed : corns and callosities form on the parts receiving pressure, and walking is painful. Manipulation of the affected joints and the application of a toe splint may be employed, but usually an operation is performed and a stiff joint procured.

Simple Exercises for Flat Foot

In the absence of a gymnast, the nurse should be prepared to teach simple exercises for this condition, and should therefore be familiar with the following :—

The special boots ordered for flat foot should always be worn during exercises. Correct walking is of primary importance, and to teach it begin (1) with the patient standing and holding the back of a chair or anything that will steady the body, with the feet apart in a line below the hip joints and with the toes pointed forwards. Practise transferring the weight first to the heels, then to the outer borders of the feet and on to the front part of the

foot until the patient is quite familiar with the procedure and fairly steady in the performance of it.

(2) Repeat, and add springing on to the toes, into tip-toe position with the maximum pressure on the ball of the great toe.

(3) Repeat this first with one foot and then with the other.

(4) Using the same procedure, attempt walking, slowly at first; taking very short steps and transferring the weight, as in standing; making a very definite point of springing on to the ball of the great toe of the forward foot, using the toe of the foot behind to assist balance. Persevere until all walking is done with attention to these points, and is a modification of this exercise.

Another exercise is to balance on the outer borders of the feet, to progress to a rocking movement backwards and forwards, and to progress further by curling the feet so that the inner borders are concave: other exercises, usually taken from standing, such as heel raising and knee bending, may also be begun from this position.

Resting positions. (1) Easy standing should be taught with the toes turned slightly inwards and the weight borne mainly on the outer borders of the feet. (2) In sitting, the feet should be inverted and resting on the outer borders. Patients should be instructed to perform voluntary inversion at fairly frequent intervals, whenever they are resting.

As improvement takes place, and the patient becomes used to walking on the outer borders of the feet, the exercises may be performed without the boots.

Claw Foot

Claw foot or pes cavus, commonly called 'hollow foot'. This condition may be primarily merely an exaggeration of the longitudinal arch, with little discomfort: the

patient finds that the wearing of an ordinary laced shoe produces pressure on the dorsum of the foot. Or the arched condition may be very definite, the only parts

FIG. IX.

Claw Foot showing Contraction of the Structures in the Sole of the Foot.

touching the ground in walking being the heel and the heads of the metatarsal bones. Callosities form on these parts. Dorsi-flexion at the ankle joint is limited, due to contraction of the tendon of Achilles, and in children it will be said that they trip over their toes ; this is caused by the limitation of this movement.

The condition may be acquired by the continual wearing of high-heeled shoes : it may be associated with other deformities such as talipes calcaneus (see page 46) : or it may occur gradually after slight paralysis of the anterior tibial group of muscles. It may be slight, severe, or very severe. In slight cases, dorsi-flexion of the foot is lessened and the gait awkward. More advanced cases will show callosities on the heel and on the balls of the toes. The great toe may become dorsi-flexed, and the extensor longus hallucis tendon be seen to stand out in contraction ; later the plantar fascia and other structures in the sole of the foot will contract, followed by contraction of the other extensor tendons and of the tendon of Achilles : contraction of this tendon may be the original cause of the condition ; on the other hand, cases are seen where only the plantar fascia and the extensors of the toes are contracted.

In very severe cases these deformities become fixed, and operative treatment is necessary in the correction of them. Slight cases may be treated by a bar across the sole of the shoe behind the position of the metatarsal heads (as described in depression of the anterior transverse arch), combined with exercises to obtain dorsi-flexion and to stretch the tendon of Achilles, such as walking up an inclined plane and heel marching.

Passive stretchings are also used : in some cases the patient may be taught to do this himself as follows :—

Seated on the floor, the legs out in front and the knees quite stiff, he passes a piece of webbing under the foot,

holds an end in each hand, and pulls until stretching of the tendon behind the ankle is felt. Cases where the plantar fascia and extensor tendons of the toes are slightly contracted may be stretched daily by the nurse, or, if the contraction is more definite, stretched and put up in plaster of Paris by the surgeon. This is usually done with the patient anæsthetized, and sometimes division of the tight structures is subcutaneously performed.

In addition to the articles usually required for the application of plaster of Paris to the foot, the nurse should prepare felt pads one inch wide, of full thickness of felt, and in strips long enough to extend across the foot. If the surgeon requires the foot to be felted, the nurse must stitch one of these strips behind the metatarsal heads under the sole, and the other over the dorsum of the toes distal to the metatarso-phalangeal joints, outside the felting in which the foot is encased. In cases where the long flexors of the toes have become contracted, a pad beneath the toes should be added, in order to straighten them as far as possible. More severe cases will probably require forcibly wrenching.

In cases where the great toe is much deformed in dorsiflexion, a tendon transplantation may be done. The extensor longus hallucis tendon is severed from its attachment at the toe and transplanted to the head of the first metatarsal bone ; but, as this deprives the great toe of an extensor tendon, the deformity of plantar flexion may follow the operation. In splinting and after-treatment the nurse should remember this. In other cases the surgeon may in addition transplant extensor brevis digitorum from its attachment into the extensor tendons on the dorsum on the foot, to the original attachment of the extensor longus hallucis on the great toe, thus providing an extensor tendon for this joint. Or, he may perform an arthrodesis of the interphalangeal joint

of the great toe. Either of these two operations will help to prevent the deformity of plantar flexion just described.

The treatment following wrenching and tenotomy is careful observation for discoloration of the toes. Any persistent pain should be reported, as the pressure may be too great and produce a sore. The plaster will probably be worn for from four to six weeks, after which the patient will wear a boot fitted with a transverse metatarsal bar. Gymnastic treatment will be ordered if obtainable; if not, the nurse should see that the patient can fully dorsi-flex the foot, and that the tendon of Achilles, the plantar fascia, and the extensor tendons of the toes do not become contracted again. The plantar fascia is most likely to contract, and, to avoid this, stretching should be performed twice a day in the following way: The nurse should grasp the heel, pressing with the palm of the hand against it on the inner plantar surface, the other hand grasping the front of the foot behind the metatarsal heads, pressing upwards until complete pliability is obtained; this should be repeated for ten to fifteen minutes.

The application of a malleable iron splint, flat beneath the sole, fitted with felt pads, applied as described in the preparation of the foot for the application of plaster of Paris in the correction of this condition, will maintain stretching of the tight structures at night.

Chapter 4

ACUTE ANTERIOR POLIOMYELITIS

Acute Anterior Poliomyelitis or infantile paralysis is an infective disease usually affecting children. The history varies from a slight feverish condition, which, in a young child, may be attributed to teething, to a severe illness, with a raised temperature, rapid pulse, diarrhœa, and vomiting, and sometimes with convulsions. The paralysis is noticed after these acute symptoms have disappeared.

The disease produces degenerative changes in the grey matter of the anterior horn of the spinal cord, which frequently results in destruction of some of the motor nerve cells. The paralysis may be fairly extensive at first, probably due to the congestion of a large area of nerve tissue. Later, when the acute inflammation subsides, improvement begins, power gradually returning in some of the muscles : this improvement continues for several months, and eventually several groups of muscles, single muscles, or a few fibres of one or more muscles only, may remain paralysed. In addition to the paralysis, the temperature of the part affected is lowered ; it often looks blue and feels cold to the touch. Trophic sores may occur ; wasting is evident ; and in some cases, especially in younger children, the growth of the bones is interfered with, the affected limb being shortened. Sensation is rarely impaired.

Any muscles may be affected ; those supplied by the

cranial nerves may be, but this is rare. The muscles of the lower extremities are more often affected than those of the upper: the quadriceps extensor, the tibialis anticus, tibialis posticus, and the peronei are amongst those frequently paralysed in the leg. The deltoid, spinati, and the muscles of the arm are more often affected than those of the forearm: the muscles of one side of the trunk are sometimes weakened by paralysis of some of the fibres, or entire muscles may be paralysed.

The disease may be divided into (1) the stage of onset, during which the febrile state and constitutional symptoms are present: (2) a period of rather extensive paralysis which gradually improves, leaving a more or less permanent paralysis; in this stage deformities occur. Deformities are due either to gravity, the adopting of bad positions, the unopposed action of healthy muscles, or a combination of these conditions.

When the case is diagnosed early, during the stage of onset, the patient is kept in bed and the constitutional symptoms are treated as they occur. Very little is known about the infectivity of this condition. Rest on a suitable splint or splints will be ordered during the period of partial recovery, and until the probable permanent paralysis can be determined. A double Thomas's splint will maintain the muscles of the trunk and hip in a neutral position, and the muscles extending the knee in the position of greatest shortening; a club foot shoe will keep the foot at right angles. The deltoid, a muscle commonly affected in the upper extremity, and one in which paralysis is a great disability, may be relaxed by pinning the sleeve of the patient's nightshirt to the mattress after the arm has been abducted to right angles with the trunk. A pillow, placed between the arm and the body well up in the axilla, may serve the same purpose; it must, however, be made so secure that the child cannot move

it. In other cases an abduction splint or a light abduction plaster may be employed. In maintaining this position care should be taken that the arm is slightly forward, in order to prevent the condition of pathological dislocation occurring at the humero-scapular joint,

Any muscle showing signs of paralysis should be adequately rested at once, and the position adopted maintained with the utmost care whenever the splint is for any reason removed. For example, in paralysis of the dorsi-flexors of the foot, maintained in position by a club foot shoe, when this splint is removed, the position can be maintained by a sand-bag beneath the foot, keeping it at right angles with the leg. If, however, the extensors of the toes are also paralysed, the sand-bag must be large enough to support the sole of the foot in its entire length from heel to toe. To carry the example further, presuming the muscles that invert the foot are also paralysed, dorsi-flexion to right angles at the ankle, and inversion at the medio-tarsal joints, must be maintained, and the toe supported in a line with the sole of the foot. A sand-bag will not maintain these three positions at once, and the foot must therefore be held, until the splint, which in this case will probably be one of specially applied plaster of Paris, is put on. Too much emphasis cannot be laid upon this point, as the entire success of the treatment depends upon the loyalty of the nurse in maintaining the positions effected by splinting. Stretching a paralysed or even a weakened muscle will retard its recovery seriously.

Another part of the treatment is to maintain warmth of the paralysed parts by warm clothing and the liberal use of hot-water bottles. Dry heat is more valuable than moist heat.

Once the resulting paralysis has become definite, the

treatment consists in maintaining the paralysed muscle or muscles in the best position suitable for recovery, i.e. with the affected fibres in relaxation. The recumbent position is not necessary, unless the muscles affected include the trunk. Treatment by splinting is usually maintained until recovery occurs. If this does not take place by the end of two years the surgeon will consider the advisability of operative treatment, if the child is old enough. During this period, massage and re-education may be ordered ; the former must be very gently done, and, in the latter, great care will be necessary to avoid fatiguing both muscle and nerve.

Deformities are commoner in the lower than the upper limb, and those in the lower limb are commonest in the foot. The entire foot may be flaccid, or one or two groups of muscles only may be paralysed.

The deformities most commonly described are Talipes Equinus, Talipes Calcaneus, Talipes Varus, and Talipes Valgus. The word ' talipes ' is derived from *talus*, the ankle, *pes*, the foot.

In Talipes Equinus (equinus, ' of a horse ', thus named as the foot is held in a straight line with the leg, like the arrangement of the bones in the foot of a horse), the dorsi-flexors of the foot are paralysed, and the plantar flexors, mainly those in the tendon of Achilles, form the unopposed group, which contracts and shortens.

The treatment consists in maintaining the foot at right angles and making plantar flexion impossible. A double iron, with stops on the boot to prevent plantar flexion, will be ordered ; or, if correction is necessary, plaster of Paris, in which the patient may walk, is applied. The boot should be cut down to the toe-cap and extra eyelets inserted, and, in putting the boot on, all plantar flexion should be avoided. A club foot shoe can be worn at

night, care being taken that the heel is well down on the foot piece of the splint to prevent contraction of the tendon of Achilles : if any tendency to this is seen, the

FIG. X.
Talipes Equinus.

application of a malleable iron posterior knee splint, in addition, may assist.

When power is returning and re-education is begun, observation should be made regarding recovery of the

muscles, as to which of the dorsi-flexors are recovering, and whether the power is equal. The nurse should notice whether dorsi-flexion is true, or combined with inversion, as would happen if tibialis-anticus were stronger than other muscles in the group, or with eversion, in which case probably peroneus tertius is recovering first.

Another important point to observe is the extent to

FIG. XI.

Talipes Calcaneus with some Cavus Deformity.

which the extensors of the toes take part in the movement. It may be seen that the patient forcibly dorsi-flexes the great toe whenever the ankle is dorsi-flexed ; in this case contraction of the extensor longus hallucis may result, thus producing a secondary deformity. To correct this, instruct the patient to plantar flex the great toe in performing dorsi-flexion of the ankle joint ; a child will understand, if told to curve the toes down at the same time as the foot is drawn up. In this way a pure move-

ment will be secured, and the extensors of the toes be put out of action. In cases where talipes equinus has remained untreated, contraction of the structures in the sole of the foot occurs, and also of the extensor tendons of

FIG. XII.

Paralytic Valgoid Deformity of Left Foot. Right Foot: Paralytic Claw Foot.

the toes, in addition to the contraction of the tendon of Achilles.

Talipes Calcaneus (calcaneum heel). In talipes calcaneus the patient walks on the heel. It is the reverse of the deformity just described ; the plantar flexors of the foot

are paralysed, and the antagonistic group, the dorsi-flexors, are pulling the foot into the position of extreme dorsi-flexion. The os calcis is displaced downwards, and in time the patient walks on the posterior surface of it instead of the plantar surface. The soft structures in the sole of the foot contract through the patient's efforts to bring the toes to the ground : in advanced cases the extensors of the toes are also contracted.

The treatment is to maintain the foot just beyond right angles, that is with the ankle slightly plantar flexed. This is usually done by means of plaster of Paris, the object being to keep the muscles of the calf relaxed. Slight cases may have the heel of the boot raised and a stiff tongue inserted in place of the usual one ; a splint should be worn at night to maintain the same position. As the muscles of the calf are important in the function of walking, even the slightest paralysis is a great disability, proving resistant to mechanical treatment, and usually some operation has to be performed.

Talipes Varus. In talipes varus the foot is inverted at the medio-tarsal joints. (This deformity should not be confused with the congenital type of talipes varus, ' club foot ', see page 9.) The peroneal group of muscles are paralysed, and the muscles that invert the foot, the tibialis anticus and tibialis posticus, being unopposed, contract and shorten : the other structures on the inner side of the foot may also become contracted.

The treatment aims at putting the peronei at rest by everting the foot. An inside iron and the boot raised on the outer side of the sole will be ordered to be worn day and night, or a removable plaster may be put on at night. Care should be taken, when putting the foot into the boot and into the plaster, to hold it in a position of eversion.

Talipes Valgus. In talipes valgus the foot is everted, the deformity being the reverse of talipes varus. The muscles inverting the foot, tibialis anticus and tibialis posticus, are paralysed, and the foot is everted by the unopposed action of the peronei muscles.

The treatment usually employed is the application of an outside iron, and the boot raised on the inner side of the sole worn by day, and a removable plaster at night. The same care will be taken in applying these, as described, above, except that inversion will be maintained. When power is returning, care must be taken to obtain pure inversion in re-education : should tibialis anticus recover first, as this is a dorsi-flexor of the ankle as well as an invertor of the medio-tarsal joints, passive inversion should be maintained during the performance of the movements. If this is not observed and dorsi-flexion only is permitted, the stronger muscles on the outer side of the dorsum of the foot would produce eversion with the dorsi-flexion, and cause stretching of the invertors of the foot, which the treatment aims at preventing.

Combinations of these deformities are also seen, the commonest being Talipes Equino-Varus, Talipes Equino-Valgus, Talipes Calcaneo-Valgus, and Talipes Calcaneo-Varus. Both the ankle and the medio-tarsal joints are included in these deformities.

Talipes Equino-Varus. In talipes equino-varus the foot is plantar flexed and inverted ; the paralysed muscles are the dorsi-flexors of the ankle and the evertors of the medio-tarsal joints. The plantar flexors and the invertors are the unopposed groups, producing contraction of the tendon of Achilles and the structures at the inner side of the foot.

The treatment aims at maintaining dorsi-flexion and eversion. A leg iron may be adapted for this purpose, or

a corrective plaster ordered, in which the patient is allowed to walk. Great care will be necessary in the re-education of these groups of muscles, as, in active dorsi-flexion, the tibialis anticus may outweigh the action of the newly recovering muscles and produce inversion, which would stretch the peronei.

Talipes Equino-Valgus. In talipes equino-valgus the foot is plantar flexed and everted ; the paralysed groups of muscles are the dorsi-flexors of the ankle joint and the invertors of the medio-tarsal joints, tibialis anticus and tibialis posticus ; in some cases the former only is paralysed. The unopposed groups of muscles are the plantar flexors of the ankle and the evertors of the medio-tarsal joints, the tendons of these groups becoming contracted.

The treatment is as described for talipes equino-varus, except that inversion instead of eversion should be maintained. In re-education of the dorsi-flexors of the ankle, care should be taken to obtain dorsi-flexion combined with inversion and not eversion.

Talipes Calcaneo-Valgus. In talipes calcaneo-valgus the foot is dorsi-flexed and everted ; the paralysed groups of muscles are those that plantar flex the foot at the ankle joint and those inverting the foot at the medio-tarsal joints. The unopposed groups are the dorsi-flexors of the ankle and the invertors of the medio-tarsal joints.

The treatment consists in maintaining the foot in inversion and slight plantar flexion. This is usually done in plaster of Paris, in which the patient may walk, until the surgeon decides whether recovery will take place or what operative treatment he will perform.

Talipes Calcaneo-Varus. In talipes calcaneo-varus the foot is dorsi-flexed and inverted ; the paralysed groups

are those that plantar flex the foot, as in talipes calcaneo-valgus, and the evertors of the foot at the medio-tarsal joints. The unopposed groups of muscles are the dorsi-flexors of the ankle and the invertors of the medio-tarsal joints. The treatment is applied as described in talipes calcaneo-valgus, except that eversion instead of inversion is maintained.

The operative treatment may consist of (1) stabilizing the foot by arthrodesis at the ankle and medio-tarsal joints ; (2) the transplantation of the tendons of healthy muscles into the attachments of the paralysed ones ; (3) tendon fixation ; (4) the correction of deformity by shortening lengthened structures and stretching contracted ones ; (5) the removal of bone wedges. This treatment will only be described in so far as observation by an orthopædic nurse is essential and to assist her in understanding the post-operative treatment ordered.

In cases where arthrodesis has been performed, the necessary fixation will be maintained by plaster of Paris, probably for several months or until such time as the surgeon orders special boots or splints. During this time the duty of the nurse will be to watch for any alteration in the appearance of the foot, which should be reported immediately.

In those cases in which tendon transplantation has been done, the surgeon will usually perform the first re-education after removal of the stitches. He will instruct the nurse when to begin daily re-education, which will probably be after a further period of two weeks or even longer, according to the condition of the muscle.

The following treatment had better be given at first without removing the plaster, which will already have been cut down to take out the stitches. Expose the site of tendon transplantation only, without altering the

position of the foot, and encourage the patient to innervate the muscle without actually performing any movement. It is a good plan to teach the patient, specially if a child, to perform the movement on the good foot first, then obtain movement of both feet simultaneously, and, in order to avoid fatiguing the transplanted muscle, stimulate it once to action, rest it for a few minutes, and then repeat the movement. Two or three actions are quite enough at first, but should be increased as nutrition and power improve. It is better to re-educate these cases for a short period several times a day, than to give one long treatment of fifteen or twenty minutes.

In cases where there is valgoid deformity of the foot, the peroneus tertius or, less often, the peroneus brevis may be transplanted to the attachment of the tibialis anticus. If peroneus tertius has been transplanted, re-education is comparatively easy, this muscle being partly a dorsi-flexor of the ankle. If, however, peroneus brevis has been transplanted, care must be taken to isolate the new movement expected of it. This muscle usually acts in conjunction with peroneus longus in everting the foot, and the latter, working on its original attachment, will produce the stronger action. It will help considerably to obtain dorsi-flexion of both feet at once. This bi-lateral movement applies in all cases where muscles have been transplanted.

In cases where the extensor longus hallucis is acting, the patient will be seen to dorsi-flex the foot by using this muscle so forcibly that extreme dorsi-flexion of the great toe will be performed at each movement. This fault is invariably made, and should be anticipated (see note on re-education in talipes equinus, page 44).

In the case of varoid deformity where the peronei are partly paralysed, tibialis anticus may be taken from its attachment and transplanted to the dorsum of the

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outer side of the foot. The same principles of re-education will then be carried out. Tendon transplantation will sometimes be combined with arthrodesis at the mid-tarsal and sub-astragaloid joints. In these cases it must be remembered that eversion and inversion, owing to the fixation of the joints at which these movements occur, will no longer be possible. The whole object of this operation is to secure a stable foot with movement at the ankle joint only.

Operations to correct deformity due to shortened structures are usually those of wrenching and tenotomy. In talipes equinus, where the tendon of Achilles is contracted, the structures in the sole of the foot and the extensor tendons of the toe are shortened, stretching the structures in the sole of the foot may be done either manually or by using a Thomas's wrench, tenotomizing the tight extensor tendons of the toes and forcing the foot up to right angles, and if necessary lengthening the tendon of Achilles also. The foot and leg are then fixed in this position in plaster of Paris, extending to the knee.

In older patients operations for the removal of bone are done to correct the shape and so improve the function of the foot in cases in which the bones are very much deformed.

Paralysis of the Muscles controlling the Knee Joint. In paralysis of any of the thigh muscles a Thomas's walking caliper may be ordered, to give stability in walking. The weight of the body rests on the ring of the caliper, which lies just below the tuberosity of the ischium. A soft leather knee shield is frequently supplied with the caliper for these cases, instead of the usual hard shield, in order to avoid pressure on the paralysed muscles. It is better treatment if a nurse can keep the knee in the

correct position by the application of a soft bandage which should not extend above the patella ; the avoidance of all pressure on the quadriceps extensor muscle is thus ensured. In applying the splint, see that the leather behind the knee is supporting the lower extremity of the femur, and not only the tuberosities of the tibia, which would produce hyper-extension of the joint. The knee shield should not be strapped too tightly across the thigh, and, in cases where great wasting of the anterior thigh muscles is present, it is advisable to place a layer of wool over the thigh before applying the shield. The caliper should be worn at night, and whenever it is for any reason removed, care should be taken to avoid moving the knee joint, particularly to avoid flexion when the anterior thigh muscles are paralysed, and hyper-extension when the posterior muscles are the affected ones.

The nurse should watch carefully for any sign of recovery, which would be shown by power returning in the muscles. To determine this, she will teach innervation of the affected groups without altering the position of the leg in the splint, practising this on the good leg first. She will teach contraction of the quadriceps extensor by placing a hand behind the knee and instructing the patient to press the knee backwards against it. The nurse will point out to the patient how this slight contraction causes the patella to be drawn up the thigh and the muscle tightened. If the leather behind the knee is sufficiently tight, hyper-extension will not occur ; this must be avoided, or the muscles behind the knee will be stretched. As power improves, the frequency of the contractions may be increased, remembering that one every few hours is better treatment than several performed in succession. The patient, if a child, may be encouraged to move the patella, ' the little bone ', once, when he sees the doctor morning and night, when

the bell rings for meals, and, if the improvement continues, each time the clock strikes.

As the strength of the muscle improves, progress is made by teaching the patient to raise the leg from the bed with the knee straight in either of two ways: in the caliper, the weight being taken by the nurse and the contraction of the muscles carefully watched, or, in a light posterior knee splint, which may be applied whilst the movement is done. For this movement the leg should be straight with the body, the patient lying, and the foot at right angles with the leg, a straight line being maintained between the anterior superior iliac spine, the patella, and the first interosseous space. In cases where sartorius is unaffected, the patient will attempt to raise the limb from the bed by using this muscle, and external rotation of the limb will occur. Where some of the flexors of the thigh are unaffected, particularly when tensor fascia femoris is acting, the limb will be abducted as it is raised. Both these faults should be watched for, carefully corrected, and avoided, as only by maintaining these straight lines just described will the movement be a pure one, and contraction of the quadriceps extensor obtained.

When this movement can be performed unassisted, extension of the knee may be taught from a slight degree of flexion. Place the patient on the unaffected side with the splints removed, and the limb lying on a polished board which is adequately supported across the bed. Slightly flex the knee, instructing the patient to straighten it by sliding it along the board, to rest; and then flex it gently, deciding and controlling the limit of flexion: repeat the movement. Progress depends on the improvement being maintained, the degree of flexion being increased, the slippery board superseded by a non-slippery one, and finally the board arranged

with an upward tilt so that the movement is performed with gravity partly eliminated.

When the knee can be fairly strongly extended from almost full flexion in this position, re-education may be begun from slight flexion at the knee, the patient lying supine. The knee being flexed over the end of the bed or table, and flexion limited by the nurse supporting the calf of the leg with her hand, the patient is asked to extend the knee, rest, and repeat the movement, increasing the degree of flexion until full power has returned.

A knee cage with side iron extending to the heel will now be ordered instead of the caliper, allowing from 10 to 15 degrees of flexion at first, increasing this as strength improves, and until the surgeon considers the splint can be omitted. During the wearing of the knee cage the nurse should carefully regulate the amount of exercise the patient may take: between the periods of exercise the patient should rest with the knee fully extended. Fatigue of the muscle should be avoided, and any inability of the patient to straighten the knee fully would indicate rest. To maintain complete extension, the application of a splint to the back of the knee at night is advisable for some time.

In cases where the hamstrings are paralysed as well as the quadriceps extensor, re-education of these should be done without permitting active movement at the knee joint. The patient, wearing a caliper, may be taught to stimulate the hamstrings, first on the good leg, later on the affected leg, without actually producing flexion at the knee. The nurse assists by placing her hands on each side of the thigh, to help localize the contraction and to observe the degree obtained. Where all the muscles flexing the knee are paralysed, a caliper bent to maintain slight flexion of the joint may be ordered,

or the heel of the boot elevated to help in relaxing the muscles.

Tendon transplantation is the operative treatment most commonly used when paralysis of the muscles controlling the knee is permanent. Transplantation of sartorius to the centre of the patella is sometimes done to assist a weakened extensor group. In the re-education following this operation, care must be taken to obtain extension of the knee with the limb straight, as previously described. Another transplantation is bringing the hamstrings to the front and using them to extend the knee : in many cases only the biceps is transplanted. In cases in which all the hamstrings have been used, it is sometimes difficult, especially in children, to teach flexion of the knee with the remaining muscles, the tendency being to hold the knee stiff and straight.

Paralysis of the Muscles controlling the Hip Joint. All the muscles about the joint may be paralysed, but the iliopsoas and tensor fascia femoris are less frequently affected. Certain groups only may be affected, such as the extensors and abductors, with contraction of their antagonists.

The treatment aims at putting the muscles at rest in relaxation, combined with passive stretchings of any that have become contracted. A Thomas's walking caliper may be ordered, or, if both sides are affected, calipers for both legs. In cases where the extensors of both hips are paralysed, some support may be added in which the patient can be taught to balance and walk.

The tensor fascia femoris and the adductors frequently become contracted. To stretch the first-named passively, with the patient lying on a table, the buttocks up to the end, fix the pelvis by flexing the unaffected thigh on to the abdomen. One person standing at the unaffected side maintains this position and also holds the

pelvis straight by the hands on each side of it : a second performs the stretching by grasping the thigh, internally rotating, and extending it slowly. This is repeated several times, and, if both sides are affected, to alternate sides. When the movement is correctly done, the tensor fascia femoris will be seen to stand out as a thick tight strand.

Another way in which the stretching can be performed is with the patient lying on the face, the thighs flexed over the end of the table : the unaffected leg is held down at right angles to the table, whilst the affected one is carried backwards into hyper-extension at the hip joint. Care should be taken during the performance of the movement to avoid abducting the leg as it is raised. The advantage of this method is that the stretching can be performed by one person, and it is the best method to teach the parents.

Stretching of the adductors may be performed from the same positions, but by abducting the thigh as well as internally rotating and extending it, the adductors will be seen to stand out.

Deformities of the pelvis must be carefully watched for during the period of paralysis. The nurse must remember that the muscles rotating the femur at the hip joint are passing between the innominate bone and the femur, and will therefore act on the pelvis as well.

Any cases of infantile paralysis wearing a caliper or calipers require careful examination as soon as they can stand, in order that deformity of the spine may not be caused in walking. If the muscles controlling the hip joints are weaker on one side than the other, unless the caliper is of full length, sufficient to compensate the drooping that occurs at the joint controlled by the weaker muscles, the trunk will swing farther over to the stronger than to the weaker side in walking. If this remain

uncorrected, a lateral deviation of the spinal column, with the convexity of the curvature towards the weaker side, may result. To avoid this, the caliper should be lengthened until the trunk is supported, so that the body swings evenly from side to side as the patient walks.

Examination should be made from the front as well as from the back, and the level of the iliac crests noticed. Children require frequent examination, and, as they grow, the splints need alteration. During examination the patient's body should be bared as low as the iliac crests.

Paralysis affecting the Upper Extremity. The muscles most frequently affected in the upper limb are the spinati, the deltoid, and the extensors of the wrist and fingers. In cases that show extensive paralysis and have been untreated for some time before being seen by a surgeon, the flexors of the wrist and fingers may be found to be acting. Examination of the position in which the limb is held will help to determine the paralysis. The treatment adopted is as elsewhere, by putting the affected muscles in positions where rest may be obtained by relaxation of the fibres.

When the deltoid and spinati are paralysed, the limb is maintained in the position of abduction at the shoulder, with slight external rotation of the humerus, either on a splint or in plaster. The nurse must see that the position is faithfully maintained when the splint is removed for changing or washing.

In the case of a patient allowed to walk about whilst wearing this splint, careful observation of the spine is necessary. When the arm is in this position, the shoulder is elevated and the splint acts as an added weight to that side, so that the patient is likely to balance by side bending to the opposite side, or the muscles overcome by the weight may allow the shoulder to droop with side

FIG. XIII.

A case of Infantile Paralysis showing lateral deviation of the vertebral column with the convexity to the side of the affected limb, wasting of left lower limb, and contraction of flexors of hip.

bending to the affected side. In either case the erect position of the spine is not being maintained, and a postural scoliosis may be the result. This must be prevented by attention to the weight of the splint, combined with the avoidance of all fatigue. Careful observation should be made of the position that the patient adopts in lying, and correction made of any lateral bending of the trunk.

If these measures are not sufficient the surgeon may order a light splint that will extend to the pelvis and so relieve the muscles of the trunk of the strain upon them. When the deltoid shows signs of recovery, re-education will be begun, the same stress being made upon slow progression as in other cases. It must also be remembered that the patient has been in the habit of elevating the arm by the use of trapezius, and this movement must be eliminated from the first, and the patient taught to stimulate the deltoid, as if to raise the arm from the splint, without performing any actual movement. Any attempt at flexion by the anterior fibres of the deltoid or extension by the posterior fibres should be avoided, as these contractions would probably be performed by the muscles attached to the bicipital groove of the humerus, and the axillary border of the scapula, respectively. As the recovering fibres become stronger, these movements may be confined to contraction of the fibres of the deltoid. When the muscle is strong enough, the splint may be removed, and the patient taught to raise the arm, first, from lying after slight adduction, increasing as the power improves ; a board should be used, as described in the re-education of the quadriceps extensor group of muscles (see page 53). Progression is made by raising the patient on pillows until the movement can be performed in full from the upright position. During this time the position of the arm on the splint

may be gradually lowered, to maintain less abduction ; and if full recovery returns, the splint may be discarded.

In cases where only partial power returns, the surgeon may decide to perform a tendon transplantation, re-education being carried out as soon as the transplanted muscles are strong enough.

In older children and in adults, where complete or almost complete paralysis remains, an arthrodesis of the humero-scapular joint may be performed. After the operation the limb will be fixed in plaster of Paris in full abduction and with slight external rotation : the surgeon may elevate the arm above right angles with the body, as upon the amount of movement of the scapula on the chest wall depends the future utility of the limb. Depression and internal rotation of the scapula, bringing the arm to the side of the body, will occur naturally, assisted by gravity. Elevation of the shoulder girdle and external rotation of the scapula is the aim of all re-educational treatment in these cases. In adult cases the degree of abduction in which the arm is put after operation is usually just less than a right angle with the trunk.

When the arthrodesis is quite firm, the muscles of the shoulder will be exposed so that they may be treated by electrical stimulation, and the patient taught to contract the muscles voluntarily, trying to get further elevation than that originally obtained by the post-operative splinting. In children this mobility will be more easily obtained than in adults, and in some cases may be so increased that the arm can be carried into the full upward-stretch position. The very slight difference between the stretching of the arm above the head on the side of the arthrodesed joint and the other side will pass unnoticed unless comparison is carefully made.

During this period of re-education the splint or plaster

held flexed against the sides as in the attitude of running. The crossing of the legs in walking has been described as ' the scissor gait '.

Examination will show contraction of the muscles adducting and flexing the hip, the hamstring muscles, and those entering into the formation of the tendon of Achilles.

The treatment aims at stretching and lengthening the contracted structures.

Special nursing measures will be adopted to relieve muscle spasm, prevent contractions and deformity, bed-sores and pressure sores. Any excitement which would increase the spasm must be avoided. By kindness and encouragement the child should be made familiar with conditions which frighten him at first, i.e. fresh faces and strange surroundings ; he should be led to take an interest in the doings of other children. Warmth will help to relieve the spasm. The temperature of the bath should be 100° Fahr. and, to avoid frightening the child, no water should be added after he is put in. The child should be lowered gently into the water, any jerky movements or loud talking or laughter being avoided ; the interest of the child should be maintained, and voluntary movements of the limbs encouraged. After bathing, a few minutes should be spent in performing slow voluntary movements of the spastic limbs, which will be found to yield to these movements, whereas a rapidly performed movement may irritate and increase the spasticity. The child, lying on a warm blanket near a fire, may be taught to lift the leg with the knees straight, and touch the nurse's hand with the toe : to avoid weariness on repeating the movement, let him carry the leg to one side or other, touching a toy or sponge with the toe.

In all movements rhythm should be aimed at ; for

example, the leg raising might be performed in time with some simple musical sound (singing 'up-down', 'up-down'). Relaxation is very important, and difficult to obtain: the nurse will find that at first every muscle of the limb will be used to perform one simple movement; for example, dorsi-flexion of the foot will be accompanied by flexion at the knee and hip, and it will require much patience before the movement can be isolated, but this is essential.

As the aim in all movements is the relief of spasm, the movements must be interesting and the most difficult ones must be repeated. At the same time boredom or fatigue must be avoided, and here the ingenuity of the nurse will be taxed to the uttermost. The attention of a patient will be more easily held in the morning than later in the day, when he may be tired and will certainly have had more distractions. Likewise, in dressing and undressing, movements should as far as possible be performed by the child, or at least the assistance of the child should be elicited whilst the movements are being done by the nurse.

Contractions will be treated by the application of splints, the nurse's duty being to see that they are well padded, fit well, and are correctly bandaged on. Bandages used should be of a firm material very evenly applied; one tight strand may cause sufficient irritation to increase the spasticity of the limb. A child, even when old enough to understand, and with the intelligence unimpaired, may not be able to discern a slight discomfort such as this: whilst a younger child, or one whose mentality is affected, may develop pressure sores if not carefully watched. Increased spasticity may be the only sign of pressure, and the slightest indication of this, especially if it occurs at night, necessitates a thorough examination. It is necessary to remove the splints night

and morning and examine the skin for any sign of redness ; suspected parts should be treated by washing and rubbing. Spastic cases are apt to bolt their food without chewing it, and therefore should be taught to eat nicely and chew the food well. It will often be necessary for the nurse to feed them, even when they are old enough to feed themselves.

In cases in which there is loss of power over the sphincter muscles controlling the bladder and rectum, an attempt should be made to re-educate this control. Every precaution should be taken to avoid nervous excitement and irritability ; for this reason these patients should not be placed too near the ward door or in a bed next to a child of the noisy teasing type. On the other hand, they should not be isolated and lonely, but should be interested in the general life of the ward, and encouraged to imitate the work and play of others : above all, they should never be laughed at or ridiculed.

In some cases passive stretchings of contracted muscles may be successful ; this is rare, as it is a forcible movement which may be resisted strongly by the patient, the resistance resulting in increased spasticity. Slow rhythmical assisted movements are of much greater value.

In slight cases of spastic paraplegia, a double abduction frame may be ordered, to stretch the adductors by maintaining the position of extreme abduction ; the knees will be kept straight by bandaging them to the splint, and the foot at right angles by the application of a club-foot shoe.

In addition to the ordinary nursing care of a patient on an abduction frame (see page 107) and the observations for the prevention of pressure sores and increased spasticity, as previously described, the nurse should watch for the least alteration of the position of the thighs in relation to the pelvis : an upward tilting of the pelvis might be due to inequality in the strength of the adductors

of both sides, or it might simply be due to the patient's slipping sideways on the saddle. In either case the position will relax the adductors of one side, and contract those of the other side, and it requires correction.

More advanced cases may require operation, either subcutaneous division of the tight tendons, or division

FIG. XV.

The application of a widely abducted frame in the treatment of Spastic Paraplegia.

of the tendons by open operation, possibly with exsection of a portion, combined with forcible stretching and the application of a double abduction frame. The patient is nursed on this frame for about three weeks, after which two walking calipers are ordered and the patient is taught to balance.

The patient is at first allowed to stand by the bed,

the legs apart and the feet directed forwards : the hands may rest on the rings of the calipers at the side : the nurse, standing behind, supports the patient, directing him to contract the abdominal muscles, in order to correct the exaggerated lordosis which is adopted, and at the same time to tighten up the gluteal muscles. The head should be held up, and the chin drawn downwards and inwards towards the neck. Constant observation should be made to keep the pelvis straight and to ensure the weight of the trunk being borne equally on both legs. The patient soon tires, and should be put back to bed with the legs wide apart, and kept in position by sand-bags, or tied to the sides of the bed. The calipers may be worn at night from the first, or the abduction frame may be replaced at night for a few weeks.

When the patient has some idea of the erect position, the support given at first may be omitted, and he may be taught to stand in an open doorway, using the sides as a support. During the periods of rest between the contractions, bad standing positions should be avoided. Later the patient may balance with the aid of two sticks, one in each hand ; the sticks should be held close to the patient in order to avoid producing flexion of the trunk at the hip joints. After this, the patient should be taught to walk ; a small child can be assisted by a nurse who from behind holds the child's hands, the arms being extended above the head : one leg is taken forward, the second brought up in a line with it, maintaining them in abduction : the patient balances, corrects the erect position, rests if necessary, and repeats the step. An older child may try with two sticks, correction of the position being made by adjustment of the trunk and legs, and of the position of the sticks between each two steps. The usual tendency shown is to carry the sticks too far forward at first.

In spastic cases it is inadvisable to assist walking by standing in front of the patient, as this produces flexion at the hip joints. The use of crutches in these cases should not be allowed, as the legs will simply be swung forward.

Another operation to correct the contraction of the adductor muscles is division of the branches of the obturator nerve supplying them by *Stoffels' Operation.*

Flexion of the knee, due to contraction of the hamstrings, is treated on similar lines; by stretching the contracted muscles on a splint in slight cases: by division of the muscles, followed by splinting and re-education, and, in some more advanced cases, by transplantation of one or more of the hamstrings to the front of the knee. The last requires very careful re-education, which is usually begun as soon as the stitches are removed. Care will be needed in cases where the muscles are very spastic, that the extensors of the knee do not become contracted by spasm during the period of retention on the splint. It is as important to re-educate flexion of the knee as extension; here again slow deliberate movements should be obtained, and all jerkiness avoided. It is also important to make careful observation after transplantation of a muscle, that the movement is performed by contraction of the muscle required.

After transplantation of the hamstrings to the front of the knee, flexion of the knee should be obtained by contraction of the deeper muscles in the popliteal space: the tendency of the patient will be to flex the knee by a lengthening of the muscles now transplanted to the front (eccentric muscle movement). In the re-education of these cases, flexion of the knees should be begun from forward lying, at first assisting the movement, then obtaining unassisted movement. When full control of both flexion and extension can be obtained from this

position, the movement may be performed from prone lying ; assistance will be necessary at first, but may gradually be omitted as progress is made. Walking is usually begun in calipers, which are later replaced by short posterior knee splints, which are left off as recovery, stability, and control of movement are obtained

Plantar flexion of the foot, if slight, may be treated by splinting to stretch contractions of the tendon of Achilles. In more severe cases, elongation of this tendon by some method may be employed, usually by the open method followed by fixation in plaster of Paris. After this operation it is essential that the knee be kept extended, and, in cases where the patient is wearing a caliper for the correction of contraction higher up the limb, walking may be permitted in the plaster about a month after the operation. When the plaster is removed and re-education begun, the boot may be fitted with stops if the surgeon considers them necessary.

In all cases of spastic paraplegia wearing boots, the heel should be kept well down : to ensure this the boot should fit properly about the ankle. In cases in which elongation of the tendon of Achilles has been performed, the nurse must watch for any indication of ' dropped heel ', the result of a weakening of the calf muscles. Re-education of these cases should not include dorsi-flexion above right angles.

Hemiplegia. In cases of hemiplegia one side of the body is paralysed, and, unless the case is treated early, deformity will arise from contractures which may be prevented by splinting, and by passive and active movements directed in opposition to the usual positions in which deformities occur.

The deformities usually seen are those described in the leg in spastic paraplegia. The deformities occurring

in the arm are adduction of the arm to the side of the body, flexion at the elbow, pronation of the forearm, and flexion at the wrist and fingers. These cases walk by taking a short step with the leg of the affected side, bringing the limb forward by a shrugging movement of the muscles controlling the hip joint, the result being a circular movement of the limb, which is partly due to weakness of the abductor and extensor groups of muscles : the trunk is inclined forward : the foot is inverted and plantar flexed.

The treatment of these cases is on similar lines to that described in spastic paraplegia. In early cases the nurse may assist in the prevention of contractions and their resulting deformities by seeing that the splints are correctly applied, and that the position of the limbs ordered by the surgeon is carefully maintained. When re-education is begun, care must be taken in teaching walking to eliminate the old habit of throwing the limb forward by shrugging the hip.

In re-educating the movements of the upper extremity, exercises requiring precision should be employed, such as counting beads on a frame, and moving pieces on a board in a game such as Halma. To encourage movement of the affected limb, the unaffected one should be tied out of the way for short periods during the day, and as far as possible the patient should use the arm at meal-times.

will be altered to maintain less abduction, as the use of the muscles elevating the scapula improves. The nurse should always see that the fullest elevation obtainable is maintained, and that the patient is able to perform this at the end of every treatment. The treatment will be begun with gravity eliminated, and progression made by alteration of the position from which the movement is performed, as described in re-education of the deltoid.

The effect of the weight of the splint, and the position of the arm on the spine, must be carefully observed, and any deviation due to this or to fatigue produced by it should be reported at once.

During the period of re-education, in many cases, it is advisable to maintain the arm in abduction at night in order to assist the maintenance of the mobility of the scapula on the chest wall, upon which elevation of the limb now depends.

Paralysis of the Muscles controlling the Elbow Joint. The biceps, supinator longus, and triceps are probably those most frequently affected. Flexion of the elbow is of more value in using the arm than extension. As extension will be obtained by gravity, the forearm is usually fixed in flexion and supination, and re-education begun as soon as any power returns. It is important to obtain flexion from right angles to full flexion ; partial flexion will already be possible, if the deeper flexors of the elbow are unaffected. In cases where all the muscles controlling the elbow are paralysed (flail elbow), the surgeon may decide to operate, or he may order some apparatus to retain the elbow in flexion.

Paralysis of the Extensors of the Wrist and Fingers, when present, will probably be put up on a long cock-up splint, to maintain extension at these joints. The nurse

must see that hyper-extension at the metacarpo-phalangeal joints does not occur. The patient should be encouraged to contract the muscles as soon as power returns; by putting her fingers under the patient's fingers as they rest on the splint, the nurse should see that when the carpal extensors are innervated, contraction of the flexors of the fingers does not occur. Similarly, when the extensors of the fingers are innervated, she should see that the flexors of the wrist do not contract. These two faults are commonly made, and patients should be taught on the unaffected hand to try to eliminate contraction of these groups acting as synergists. Next, the position being maintained but with the splint removed, the forearm lying supinated on a firm pillow, the hand over the end so that gravity is assisting the movement, active extension of the wrist and fingers should be obtained. As power returns in the extensors, the movement can be performed with gravity eliminated, by placing the forearm and the hand ulnar side down on a slippery surface, increasing flexion as power returns in the extensors, then permitting flexion to be made actively, progressing until extension is possible in the whole range of the movement and from any position.

The extensors of the wrist and fingers are a group of muscles which in an untreated case will have been subjected to a great deal of stretching; for this reason a considerable time may elapse before signs of recovery are seen. When recovery does not occur, a tendon transplantation may be performed, some of the carpal flexors being transplanted to the back of the wrist and used as extensors. Similarly, in paralysis of the flexors of the wrist and fingers, the carpal extensors may be transplanted and used as flexors. The post-operative treatment will be the same as in any tendon transplantation (see page 49).

In all cases where tendon transplantation is to be performed, the muscles to be transplanted should be treated by frequent voluntary contractions during a period of three weeks before the operation.

Paralysis of the Muscles controlling the Trunk will cause deformity of the spinal column. Every case of infantile paralysis should be examined for any weakening of these muscles by paralysis of some of the fibres. The straight abdominal muscles (recti-abdomini) are brought into action by the patient's voluntarily raising the head from lying, the nurse determining the power of both sides and making comparisons of each side, and also of different segments of the muscle. The other abdominal muscles may be tested by raising the legs, and by raising the trunk from lying, both movements being assisted by the nurse, and any deviation of the part to either side noticed. Inclination of the trunk in raising would be to the stronger side and away from the weaker. A hand placed firmly above the knees as the patient lies will enable this movement to be more easily performed.

To test the muscles of the back, the patient lies on the face, clasping the hands behind the back and raising the head from the bed. The movement is repeated, the shoulders being raised as well. The nurse should notice whether the body inclines to one or the other side ; this denotes weakness in the muscles of the opposite side. Next, to test the muscles that bend the trunk sideways, use the same starting position, but with the arms parallel with the body ; the patient raises the head and shoulders very slightly, then inclines the body first to one side and then to the other. A considerable amount of assistance will be required in performing these movements.

When any of the muscles of the trunk are paralysed,

rest can only be obtained by means of the recumbent position. These cases are usually nursed on a double Thomas's splint, until the paralysis can be definitely ascertained, and they remain on it, when necessary, until recovery takes place. When the surgeon considers the patient may get up, some apparatus of the nature of a spinal jacket will be ordered, to maintain the erect position of the trunk.

Deformity of the spine is a very serious disability, and careful observation of the muscles controlling it will be necessary (see Chapter 8).

Paralysis of the Muscles controlling the Head. Any of the muscles controlling the head may be affected. If the anterior muscles of the neck are paralysed, the forward cervical curve will be exaggerated, and the patient unable to control the movements of the head. A collar or some light support will usually be ordered to be worn until the patient regains this power. A torticollis may result from paralysis of one sterno-mastoid muscle (see page 24).

Summary of the Principles employed in the Treatment of Infantile Paralysis

(1) Rest for the whole body during the acute stage.
(2) Isolation, especially from children, during the first six weeks of illness.
(3) Warmth to promote circulation, thus ensuring nutrition and the removal of waste products.
(4) Adequate splinting of the paralysed muscles in positions of relaxation.
(5) Avoidance of any stretching of paralysed muscles, by the utmost care in handling : the maintenance of the position of the splints, and immediate detection and repair of any injury to them.

(6) Prevention of contractions occurring in the unopposed groups of muscles, and treatment by the use of passive stretchings, should they occur.
(7) Avoidance of pressure on the paralysed muscles by tight bandages, splints, straps, or any other appliances.

On Getting Up

(1) Careful maintenance of the position secured by splinting is necessary, with very frequent examination for breakages, loose straps, and the wearing out of apparatus.
(2) Avoidance of general fatigue.
(3) Careful observation of any tendency to deformity, particularly of the back and pelvis.
(4) Periodical inspection of the splint to ensure accurate fitting in a growing patient.
(5) Preserving the position required when changing to night splints.
(6) Careful attention and guidance of the patient with regard to positions adopted during rest and work.

In Recovery of Muscles

(1) Secure voluntary movement of recovering muscles, being content with one contraction at first, and progressing slowly.
(2) Isolate the movement to the recovering muscles as far as possible.
(3) Avoid fatigue of the paralysed muscles, which would be shown by decreasing power; when this occurs, omit all voluntary movement for a week, then try again.

(4) Perform all movements at first only within the inner range, i.e. with the affected muscle fibres in the greatest degree of relaxation.
(5) Never stretch a paralysed or a partly paralysed muscle.
(6) Teach all movements on the good side first.

Chapter 5

SPASTIC PARALYSIS AFFECTING CHILDREN (LITTLE'S DISEASE)

Spastic Paralysis is a disease of the upper motor neuron affecting the control of movement rather than power, combined with weakness and rigidity. It may affect the lower part of the body (*paraplegia*), one side of the body (*hemiplegia*), both upper and lower extremities on either side (*diplegia*), or only one limb (*monoplegia*).

The condition may be congenital, may be due to injury at birth, or may occur later due to hæmorrhage, injury, or disease. The symptoms are spasticity in the performance of movement, exaggeration of the reflexes. Deformities occur as some groups of muscles are stronger than others, resulting in contractions of the stronger groups. The contracted groups are frequently the flexors and adductors of the limbs. Feeble-mindedness may be present, varying in degree from a slight almost unnoticeable condition to complete idiocy.

The condition may pass unnoticed until the child is old enough to stand and walk, when the mother may think the child is backward and consults a doctor. She describes the child as stiff and awkward in movement, nervous and irritable, clutching at the furniture without any real idea of balance. She may also notice that the child's legs are pressed together or cross each other.

Spastic paraplegia is the type most commonly met with. The patient may be mentally deficient, and, if not, will probably be either very irritable or placid. The gait of the patient is stiff and awkward, the thighs flexed and

FIG. XIV.

A case of Spastic Paralysis, showing the adduction and flexion of the hips, crossing of the legs, and deformity of the feet.

adducted, the legs pressed together or crossed, the knees flexed, and the feet plantar flexed and inverted.

The patient walks on the toes : as one leg is raised, it is thrown forward in front of, and often across, the other. The body inclines forwards, and the arms are

Chapter 6

RICKETS

Rickets is a constitutional disease due to defective nutrition, and manifests itself mainly in bone lesions. It is usually seen in the early years of child life, and most often where overcrowding, insufficient feeding, absence of sunlight and fresh air, and generally bad hygienic conditions prevail. It must, however, be remembered that rickets is sometimes seen where the hygienic conditions are good, and in cases where a child is apparently being properly fed The history given will vary.

During the early stage the treatment is mainly dietetic, combined with good hygienic surroundings, plenty of fresh air and sunlight. The principles of dieting are : Food rich in vitamins ; fresh fruit, especially orange juice ; fresh meat if the child is old enough, otherwise the red gravy of beef ; fats, particularly cod liver oil and milk fats ; and the reduction of carbohydrates, especially sweets and cakes.

The result of this defective metabolism on the bones is enlargement of the epiphyseal cartilages, there having been an extensive amount of cartilage formed with little deposit of bone. This enlargement is usually marked at the ends of the ribs where they are attached to the costal cartilages, and also at the wrists and ankles, probably because here there are two bones side by side and the epiphyseal enlargement is therefore more noticeable.

These changes in the bones are commonly described as

being marked by three stages: (1) the stage of congestion, in which there is irritation due to the altered metabolism resulting in enlargement at the epiphyses; (2) a stage of softening, where there is cessation of the process of ossification (at this stage deformity occurs); (3) the stage of recovery, when the bone receives lime salts in its enlarged state.

One of the most usual deformities occurring in rickets is enlargement of the epiphyseal cartilages, specially marked at the wrist and ankle. The enlargements at the end of the ribs are described as 'the rickety rosary'

The majority of other deformities are either exaggerations of the normal curves of the bones, the result on the softened bones of weight bearing in positions of sitting, crawling, and walking. The fontanelles are unusually large, and close late; the head may be long or square, and the frontal eminences enlarged; the chest is flattened from side to side; the sternum projects forwards, forming the 'pigeon breast'; the lower ribs are turned outwards over the distended abdomen. In severe cases the chest shows two grooves, one in the axillary region (Harrison's sulcus), and the other along the outer side of the cartilagenous ends of the ribs. The spine, especially if a habitual sitting posture has been maintained, will present a long round posterior curve (the 'long round back'). If, with this deformity well marked in the lumbar region, the child begins to walk, the so-called 'flat back' develops. If, however, this deformity is not well marked in the lumbar region, an exaggerated lordosis occurs, to compensate the exaggeration of the normal curve in the dorsal region. Lateral deviations of the spinal column and deformities of the pelvis may also occur. The arms may become deformed by the child's crawling or supporting itself on them when sitting on the floor.

The commonest deformities are those occurring in the

lower limbs, due to weight bearing whilst the bones are soft. Those frequently seen are :

(1) External rotation of the femur.

(2) Coxa vara, a decrease in the normal angle of the shaft of the femur with the head.

(3) Increase of the normal outward bowing of the shaft of the femur below the neck.

(4) Increase in the normal forward curve of the shaft of the femur, sometimes combined with alteration in the shape of the bone.

(5) Knock knee (genu-valgum), the lower extremity of the femur and the upper extremity of the tibia taking part in this deformity, or the femur only being deformed.

(6) Outward bowing of the bones of the lower limb with the maximum deviation at the knee joint (genu-varum).

(7) Outward bowing of the legs below the knee (' bow-legs ').

(8) An anterior bowing of the shaft of the tibia, usually most prominent at the lower third.

The treatment aims at the prevention of deformity. The recumbent position is ideal ; in young children this can be obtained by the application of webbing straps to prevent the child from sitting up, or by putting the child to lie on a well-padded board which extends from the shoulder to the sacrum and is kept in place by broad straps across the body. If the child tries to sit up, straps made of broad webbing may be applied across the shoulders and fastened to the sides of the cot.

The use of napkins tightly applied or of a strong material, should be avoided, as these may externally rotate the thighs or cause a little outward bowing of the femur. No tight clothing ought to be worn, or heavy bedclothing used : in winter, cover the limbs with light warm woollens, and allow the child plenty of room to

kick ; in warmer weather, allow him to lie with the limbs exposed to the sun and air. Daily massage or rubbing with olive oil will assist nutrition.

Incipient deformity can be corrected by manipulation. Cases of acute rickets, with pain present, are sometimes

FIG. XVI.

Deformities of the lower limbs in a case of advanced Rickets, showing over-lapping of the knees in knock-knee.

treated by recumbency on a double Thomas's splint, in order to avoid any movement.

The treatment of deformity depends on whether the bones are still soft or are hardened ; in the majority of cases the bones will be quite hard and the deformities fixed by the fourth or fifth year of age.

Tibial bow-legs is one of the commonest deformities: if the bones are still soft it may be corrected by manipulation. A simple manipulation may be performed by tying the legs together at the knees and ankles, and applying pressure over the maximum deformity on the outer side of each leg, repeating the manipulation for a few minutes several times daily. The force used should

FIG. XVII.

Bowing of the lower limbs in Rickets (genu-varum).

not be sufficient to cause pain. Cases that do not improve under this treatment, or that are considered unsuitable for it, will probably be forcibly corrected, and the correction maintained by splints. As the orthopædic nurse will attend to these cases, she should be familiar with the procedure :—

Two malleable iron splints are required, one long

enough to extend from above the knee to beyond the foot on the inner side of the leg, and one shorter for the outer side, padded with felt and wool : also felt or wool rings for the inner condyle of the knee and the internal malleolus, and pieces of strong bandage to tie the splints together, and bandages. The operator requires an assistant to steady the knee by placing one hand on either side of the joint, the hand on the inner side to be placed over the internal tuberosity of the tibia and the one on the outer side over the external condyle of the femur : the hand on the inside applies pressure outwards, and the hand on the outside inwards, to maintain stability of the joint during the process of correction. The operator now grasps the leg at the lower end of the tibia on the inside, and with the other hand exerts pressure on the middle outer aspect of the leg over the maximum deformity, until all spring is out of the bone and it remains corrected. The limb is then powdered with a simple starch powder and the splints applied, first the inner one ; an assistant holds this in contact with the leg by grasping it at the knee and ankle. The outer splint is next applied, and both splints are secured by bandage ties at the junction of the upper and middle, and middle and lower thirds, of the splints respectively ; the whole is completed with the application of a firm roller bandage. The inner splint, which extends below the foot, is now bent in across the sole. A general anæsthetic may or may not be necessary.

The nursing consists in the observation of the colour of the foot : in most cases it is advisable to remove the splints after about four hours, and in all cases they should be taken down before night in order to prevent pressure sores. Two nurses will be required : the bandages are removed and one splint is taken off at a time, one of the nurses holding the leg in contact with the remaining

splint while the second nurse performs the treatment. All parts subject to pressure should be well washed, rubbed, and powdered. These splints will be worn as long as necessary, and the after-treatment consists in keeping the child off its feet until the bones are hard.

In cases where correction by manipulation is not possible because of the hardness of the bone, either the operation of osteoclasis or that of osteotomy will be performed. The former consists in breaking the bone by means of an osteoclast, and splinting the legs, which are then treated as a simple fracture. The latter is an open operation, in which the tibia is divided at the point of greatest deformity ; for this the skin needs preparation. Post-operative treatment consists of simple surgical nursing. If the application of the splints in either of these cases is left to the nurse, she should avoid obtaining any over-correction.

Knock Knee. Knock knee is usually the result of weight-bearing. An X-ray photograph will probably show irregularity of the epiphyses of both femur and tibia. Both bones may take part in the deformity, or the femur only, and there may be external rotation of the femur in addition. The gait of an advanced case is an awkward one, the legs being thrown outwards and the body swung from side to side to assist progress. Cases neglected in early childhood may complain of pain on the inner side of the knee and will tire easily.

Examination of the knee with the limb extended may show slackness of the ligaments on the inner side and contraction of those on the outer side ; lateral movement will be possible at the joint, more or less considerable according to the degree of laxity. On flexing the knee it will be seen that the deformity disappears : this suggests the importance of examining these cases with the

joint fully extended. The best treatment, as in all rickety deformities, is preventive.

In cases in which there is a tendency to knock knee, slightly raising the heel of the boot on the inner side might be sufficient to prevent bad deformity later. In cases

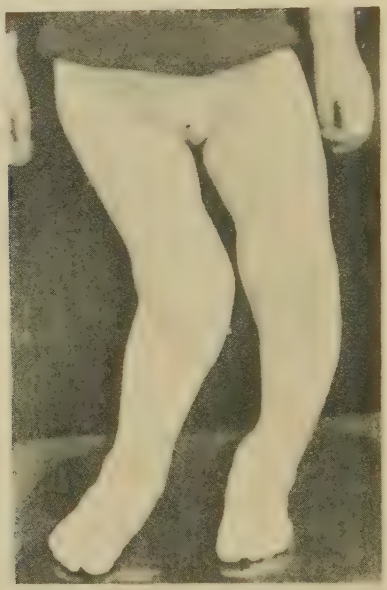

FIG. XVIII.

Deformities due to Rickets. Right Leg : Knock-knee. Left Leg : Bow-leg.

where slight deformity is present, massage and manipulation may be ordered, the former to improve the musculature of the thigh, the latter to correct deformity. A useful manipulation with the knees straight is the application of pressure over the maximum deformity on

the inner aspect of the joint, with counter pressure applied on the outer side above and below the joint.

More advanced cases are usually ordered an outside iron for the leg, in addition to raising the boot on the inner side. In a child old enough, exercises which aim at strengthening the muscles that stabilize the knee joint will be added to the treatment. Still more advanced cases may be treated in irons, such as the Thomas's knock-knee iron, which consists of a bar on the outside of the limb inserted into the heel of the boot by means of a hollow tubing : a pad is placed at the upper end of the outside bar to come against the thigh ; a short posterior bar lies behind the knee. Some splints are provided, with a pad attached to this bar that may be adjusted as required, to prevent hyper-extension of the joint.

In applying the splint, the inner condyle of the knee is protected by a thin layer of wool, the bandage being carried over this for three or four turns before including the splint, in a direction from without inwards, in order to correct any rotation of the femur. Continue the bandage over knee and splint, drawing the knee to the outer bar, and fastening the bandage securely with a safety-pin. These cases require frequent observation, as upon the firmness with which the bandage is applied the success of the treatment depends. In cases where this splint is replaced by a posterior knee splint at night, careful padding to avoid hyper-extension will be necessary. Cases too resistant for simple mechanical treatment may be corrected in plaster of Paris, a series of plasters being applied, each slightly more corrective than the last, until the limb is straight. This treatment will be followed by the application either of a Thomas's knock-knee iron or a short outside leg iron, and boot raised on the inner side.

The operations usually performed for still more

advanced cases are either osteotomy of the femur or osteotomy of the tibia. The limb will be put up either in plaster of Paris or splints of some kind after the operation and simple surgical nursing measures are all that will be required.

In cases of child patients having been treated in splints for the correction of ' knock knee ', either primarily or after correction in plaster of Paris, careful observation will be necessary, when the surgeon orders the splints to be omitted, in order to prevent recurrence of the deformity. It is better to omit the splints gradually at night first, then for a short daily period, increasing the period until at the end of one or two weeks they are no longer required.

Coxa vara is a deformity less frequently seen, and may not be noticed until the child is older and the deformity a fixed one. It is due to a depression of the neck of the femur, decreasing the angle between the head and the shaft, combined with a torsion of the femoral neck. The symptoms are a waddling gait, increased lordosis, the child walking with the thighs outwardly rotated. Examination will probably show the great trochanter above Nélaton's line (Nélaton's line is a landmark used to determine the centre of the hip joint, extending from the anterior superior spine of the ilium to the tuberosity of the ischium). Normally this line will pass across the top of the great trochanter. Abduction and internal rotation of the femur at the hip joint will be found to be limited.

The treatment, if the child is young and the bones still soft, is largely manipulative, aiming at increasing abduction and internal rotation, which to be of value must be limited to the hip joint. In performing these manipulations, have the child lying on a firm table, the

FIG. XIX.

X-ray photograph showing the decrease in the angle of the femoral neck in a case of coxa vara.

pelvis fixed by flexing one thigh on to the abdomen, the position maintained by an assistant, who also steadies the pelvis whilst the manipulation is performed, and repeated to alternate sides. This treatment is only of value in very slight cases ; usually a double abduction frame is applied, with slight abduction at first, which is gradually increased, and the limbs bandaged on the splint in a position of internal rotation from the hip joint. The bandages are removed daily for the manipulations of abduction and internal rotation. When the child is allowed to get up, a splint will be ordered, to take the weight off the femur until the bones have hardened, whilst massage and exercises, including the manipulations before described, will be performed daily.

In cases where the deformity is rigid and is so marked as to be a serious disability, osteotomy may be performed after adolescence, and the case nursed either on an abduction frame or in plaster of Paris.

Deformities of the spine are treated by recumbency, massage, and exercises, and, if necessary, with a light spinal support. Deformities of the arms are of little disability though unsightly ; those due to epiphyseal enlargement will to a large extent disappear under dietetic treatment.

Chapter 7

TUBERCULOUS ARTHRITIS

Tuberculosis is an infective disease caused by the tubercle bacillus. There are two varieties of the tubercle bacillus which cause disease in man—the human and the bovine types. In children and young people disease of the abdomen, glands, joints, and meninges is more common than pulmonary tuberculosis. The conditions of environment that predispose the child to tuberculosis are living with persons suffering from the disease, poverty with resultant underfeeding and underclothing, unsuitable dwellings, insanitary conditions, absence of both fresh air and sunlight. Hereditary transmission of this disease is rare; inoculation is uncommon; inhalation and ingestion are the most general paths of infection. In young children probably the most usual source of infection is bovine, transmitted by the drinking of infected milk.

Tuberculous disease of the spine (Pott's Disease) usually begins at the front of the bodies of the vertebræ; the cancellous bone tissue is eaten away, cavities form, and the bodies of the vertebræ collapse, producing an angular deformity called a kyphosis. In some cases where tuberculosis begins in the interior of the bodies of the vertebræ, the disease may progress backwards and pressing on the spinal cord cause early paralytic symptoms.

The early history may be very indefinite ; lack of energy, listlessness, wasting, inability to concentrate, the child moaning and crying in sleep and waking unrefreshed, a poor appetite. An observant parent might notice that the child seemed stiff, and that he did not move easily, holding on to the furniture to get about the room, and seemed disinclined to play.

Examination will show stiffness of the part affected, according to the severity of the disease and the amount of irritation present ; the rigidity may include the whole of the back or only limit certain movements of a part of the back.

The patient should be stripped to below the iliac crests, and free movement of the vertebral column tested in all directions, flexion (forward bending), extension (backward bending), lateral flexion (side bending), first to one side and then the other, rotation (turning). These movements should be as pure as possible, and, to obtain this, the pelvis should be fixed with the hands to prevent the hip joints taking part in the movements. The movements of the child in walking, stooping, sitting down and getting up should then be observed, and any stiffness or awkwardness noticed.

On admission to hospital the nurse would note the following particulars : Family history—parents, grandparents, brothers and sisters alive ? if dead, cause, any tuberculosis ? Personal history—previous illnesses. Environment—address ; school ; father's occupation ; house, situation, size, and type ; has the patient a separate bedroom ? separate bed ? and open windows ? is there a garden or backyard ? and is any one living in the same house suffering from tuberculosis ?

A patient admitted to hospital as suffering from a tuberculous spine is treated as such from the beginning, without waiting for a confirmation of the diagnosis.

Before any special fixation is applied, the principle of rest should be borne in mind in carrying out all nursing measures. Voluntary movement by the patient should not be permitted ; any movement necessary should be performed with the patient lying flat, avoiding all jarring, rotation, and flexion of the vertebral column. An X-ray

FIG. XX.

Pott's Disease, showing kyphosis in the dorsal region of the vertebral column.

photograph will probably be ordered to assist diagnosis.

Immobilization of the vertebral column may be applied in various ways ; the method here described is the application of a double Thomas's splint. For disease of the cervical region of the spine, a splint with a sunken head-piece will be ordered, complete with saddle : in

addition a wrench will be required to adjust the bars, also bandages, splint wool, safety-pins, and a collar. In applying the splint the nurse should see that the saddle is not too low for nursing purposes, and that the bend in the splint corresponds to the gluteal fold of the patient, so that the tuberosity of the ischium rests on the bar above the bend. The nipple and pelvic bars should be brought up close to the patient's body, to prevent lateral movement, and adjusted by means of the wrench, which should be applied where the wings join the vertical bars of the splint behind ; the shoulder straps should be fastened with the chest in the position of full inspiration.

As the head will rest on the head-piece, the hair should be cut short at the back before applying the splint ; and in cases in which the head is verminous, it is a wise precaution to smear the scalp with white precipitate ointment, after the usual cleansing process, before the splint is applied. The nurse should be careful to see that the neck is supported by the bend in the head-piece, and a collar applied, round the neck and also round the head-piece, the free ends of the calico being brought forward and stitched in front so that the child cannot undo them.

The collar can be made of stiff brown paper, a triangular piece being cut and folded from apex to base until it is two to three inches wide as required, and enclosed in calico cut and folded in the same way.

The pelvic and knock-knee bars should now be brought close up to the patient : the saddle should extend to the knee joint ; failing this, a pad of wool behind the lower end of the femur will prevent hyper-extension at this joint. The legs should then be bandaged to the frame, the bony parts being protected by cotton wool : the bandage should be taken over the knock-knee bar, but

should not cover the crutches at either end of the bar, nor should it be brought low upon the dorsum of the foot, as this might obstruct dorsi-flexion.

Nursing. The bed is made up in the ordinary way with a long mackintosh sheet, short mackintosh, and draw-sheet; if the bed sinks in the middle, light fracture boards may be put in below the mattress. The upper bedclothes require to be light and warm; patients sleeping out of doors should have a light blanket next to them. If the bedclothes press on the feet, a low cage may be put in; in all cases, whenever the bed is made, it should be ascertained that the patient can move the feet freely, and especially that full dorsi-flexion at the ankle joint is possible.

The personal clothing of the patient should fasten down the back; a flannel nightdress is advisable; vests should not be worn, as the movement entailed in putting them on would be harmful; knitted sweaters large enough to go over the splint and the body may be worn by patients sleeping out of doors in the winter. If bed socks are used, they should be made with a foot like an ordinary sock; the usual straight type would impede movement of the foot. When hot-water bottles are used, care should be taken that they are not placed against the iron of the splint, in order to avoid the danger of burning the patient. In cases where a sunken head-piece is ordered, a firm pillow, the width of the shoulders and sufficiently thick to prevent the back of the head resting on the bed, should be put in. For bed-panning a patient on this splint a block of wood the same thickness as the pillow should be put under the cross bar at the bottom of the splint, to allow the bed-pan to be placed in position without tilting the splint up from the bottom, as this

would cause strain on the head-piece and interfere with immobilization.

The parts uncovered by splint or bandage may be washed night and morning, attention being paid to any folds of fat about the buttocks and groins. To wash the buttocks when the splint has a head-piece attached, the patient should be moved to the side of the bed until the head-piece lies beyond the mattress, when the splint can

FIG. XXI.

Pott's Disease on double Thomas's hip splint with sunken head-piece, showing block under shoulders to prevent the head-piece resting on the bed.

be tilted without danger of straining the head-piece. When the legs are washed, which should be less often and may correspond with the twice-weekly bath, care should be taken not to allow the patient to perform any voluntary movement at the hip joint: all movements of the limb should be reduced to the minimum, and care taken not to hyper-extend the knee: one leg should be washed and re-bandaged before the other is undone. In washing the

neck of a patient wearing a collar, it is often necessary to have a second nurse to steady the head.

In lifting a patient from the bed, all bed-clothing except a light blanket should be removed, and the patient

FIG. XXII.

Pott's Disease on double Thomas's hip splint, showing method of lifting the patient.

lifted after the following manner : By taking hold of the nipple bars with one hand and the horizontal bar between the legs with the other, the patient if a small child can be carried by one nurse : for a heavier patient two nurses are necessary.

For disease in the dorsal and lumbar regions of the spine the same splint is used, with the exception that when the disease is in the middle or low dorsal region, only a straight, not a sunken, head-piece is required: these cases are nursed flat on the bed without a pillow, and, unless restless, do not need a collar. When the disease is in the lumbar region, two groin straps are sometimes applied to prevent lateral movement in a restless patient. Restlessness and crying should always be attended to; they may be due to some childish intestinal trouble, or may mean a pressure sore. To ascertain this, all pressure points, padding, bandages, and the fittings of the splint should be examined. If nothing is found, and the patient has a marked deformity of the spine, turning may be necessary to discover whether pressure over the kyphosis was the cause of the restlessness.

To turn a child patient four nurses are necessary, more being required for an adult. Place the patient on a narrow table, unfasten all bandages and ties, and turn out the bars with the wrench; one nurse should stand at the head of the table, another at the foot, and one at each side. One nurse should give the commands and decide beforehand in which direction the child is to be turned over. The nurse at the head grasps the child at the axillæ; the child clasps his hands behind his head to support it. The nurse at the bottom grasps the lower limbs behind and just above the knees, allowing the calves to rest on her forearms. The nurse at one side of the table takes hold of the body at the pelvis. On the command 'One, two, three and LIFT' the patient is raised from the splint, sufficient traction being put on axillæ and thighs to maintain the trunk in extension; the fourth nurse removes the splint and places a blanket on the table. On the command 'TURN' the patient is turned over, and on the command 'LOWER' is placed on the table

with the feet beyond the end (if the dorsum of the feet were permitted to lie on the table, slight flexion of the knee joints would be produced, which might cause pain in the case of a patient who had been a long time on the splint). The back is examined for signs of pressure, carefully washed, rubbed, and powdered, and the splint is re-applied, with the order of movement reversed but the same commands used. Re-application of the splint requires the same care as in the original application.

A simpler and less dangerous method of turning a patient on this splint is that used at the Shropshire Orthopædic Hospital by means of the plaster case originally made and used by Dame Agnes Hunt, R.R.C., and described in her book on Joint Tuberculosis.

The turning is performed as follows : The patient on the splint is laid on a table ; a strap is placed beneath the splint below the nipple bars ; the personal clothing is removed, all ties loosened, bandages removed, the nipple and pelvic bars of the splint pressed back out of the way, and the turning case placed in position on the front of the patient's body, over which the strap is securely fastened. The nurse should see that the buckle is at the side where it can easily be reached when the patient is turned over. Two smaller straps are fastened round the legs above the knees, and when all the straps are secured, the patient is turned over with the feet brought over the edge of the table. The straps are then unfastened, the splint removed, and the patient remains lying in the turning case during the washing, rubbing, and other treatment that may be necessary : after this the splint will be replaced, strapped on, the patient turned, and the splint re-adjusted as before.

In cases which have undergone prolonged splint treatment before operation, the knee joints may have stiffened

from disuse. This should be ascertained some weeks before the operation, and, if necessary, the patient turned and the knee moved very gently, and as often as needed, until flexion above right angles can be easily obtained ; otherwise the surgeon might not be able to obtain enough flexion of the leg for the removal of the graft from the tibia.

The duration of the splint treatment will depend on the age of the patient, the degree of deformity, the presence of complications, and whether or not the surgeon considers an operation for spinal fixation can be performed. Either of two operations may be performed—the ' Albee ' and the ' Hibbs ' : the former necessitates the removal of a graft of bone from the inner side of the tibia, and the transplantation of it into the spines of the vertebræ over the diseased area and for a distance above and below it : the latter does not necessitate the taking of a graft, so that only the skin of the back will need preparation. It is important for the nurse to remember this in preparing cases for these operations. The use of a turning case will facilitate the preparation of the back, and in many cases the operation is performed with the patient lying in the case.

A month's preliminary treatment on a double Thomas's splint is frequently ordered in the case of patients who are admitted to hospital primarily for this operation, in order that they may get used to the position.

After the operation the dressing should be very carefully applied in order to avoid pressure. Large flat folded pieces of sterilized gauze are laid on the back first, followed by sterilized absorbent wool, which should be sufficiently flat and even to prevent any pressure over the site of operation, when the patient is back on the splint. The leg from which the graft had been taken also requires a sterilized dressing, and the application of a short posterior

knee splint and club-foot shoe will minimize the possibility of jarring the injured leg.

During the first hours after operation these cases suffer considerably from shock and should be nursed in a warm room. It is often necessary to raise the foot of the bed on blocks until the patient has recovered from the anæsthetic. Rectal salines may be ordered until the patient can take fluids by mouth. As a rule the dressings do not require attention until it is time for the removal of the stitches ; those from the leg are usually taken out a couple of days before those in the back.

The patient will be nursed on this splint for several months and then measured for a Thomas's spinal support. In applying this support the patient should be turned in a case ; the support should be tried by laying it in position on the back and pressing it against the sacrum, when the upper part should rise well off the shoulders ; the curve of the splint at the lumbar region should be altered until this can be obtained. The patient is then turned over on to his back, and the turning case removed ; the pelvic straps of the spinal support should be fastened first, then the groin straps and shoulder straps simultaneously, lastly the webbing strap round the abdomen, which need not be tight. The nurse should notice particularly into which holes the groin and shoulder straps are buckled in the first instance.

The patient will continue to lie in bed wearing this splint for a further period of several weeks, being encouraged to move the legs : when possible, he will be given massage and exercises daily. The parts subject to pressure, the groins, axillæ, and iliac bones will require attention twice daily, and oftener when the patient begins to get up. As the leg from which the graft has been taken will have been weakened, the nurse should observe the effect of walking, as knock knee may occur.

The spinal support will be worn for a varying time, probably years, and will require renewal from time to time. In cases where the disease is in the lower dorsal and lumbar regions of the spine, a plaster spica will be

FIG. XXIII.
Thomas's Spinal Support.

applied instead of a spinal support, and should extend well above the lower ribs in order to control movement of the spinal column.

Complications. The commonest complications are abscess formation and pressure on the spinal cord.

After an abscess has formed, it may remain near the affected part or find its way to the surface by tracking along the course of some muscle. An abscess due to disease in the cervical region of the spine may appear at the side of the neck in relation to the sterno-mastoid muscle : other positions in which abscesses are commonly seen are the psoas muscle and the muscles in the lumbar region of the back.

Abscesses may respond to general treatment and rest, or may need aspirating.

Pressure on the spinal cord may cause paresis or paralysis of the spastic type with exaggerated tendon reflexes and frequently with ankle clonus and muscle spasm. In untreated cases the pressure may cause deformity of the lower limbs as the result of this spasm. Incontinence of urine is frequently present, and there may be loss of control over the anal sphincter in addition.

These cases require constant observation in order to prevent pressure sores, any increase in the spasticity suggesting irritation which might be due to a sore on some part of the body.

Tuberculous disease of the hip joint is a chronic disease, and usually begins near the epiphyseal cartilage of the head of the femur, gradually forcing its way into the joint, destroying the hyaline cartilage.

The history, in addition to the general condition described in *Tuberculosis of the Spine*, will be pain and limp, although in many cases the pain passes unnoticed, possibly being due to sudden movement or over-fatigue, and therefore not always present. When present, it may be referred to the inner side of the knee. A very important factor of the history is ' night cries'. These are due to the relaxation of the muscles controlling the joint, which

during the day are constantly on guard maintaining a varying amount of rigidity; during sleep these relax, the sensitive areas of diseased bone rub together, and cause a sharp cry; the child may not wake, and, if wakened, will not be conscious of pain. A mother or nurse may notice that during sleep the child's hands are holding the thigh as if to support and protect it.

FIG. XXIV.

Application of the H. O. Thomas test to ascertain the flexional deformity present in the affected (left) hip-joint.

Limping is probably the most noticeable early sign, more marked when the child is fatigued, or when getting up after resting. It consists of a shortened step, the child resting a shorter time on the foot of the affected leg, and as the disease progresses, less weight is transmitted to the heel, the patient walking on the front part of the foot, the heel being elevated by plantar flexion. Slight flexion

of the knee and hip also occur in the patient's effort to save the affected joint from being jarred.

On examination rigidity will be noticed. Flexional deformity may be gauged by means of the H. O. Thomas test, the patient lying flat with the good leg flexed on to the abdomen. Whereas in the normal the opposite leg will continue to lie in a line with the body, in diseased conditions where there is irritation at the hip joint, the rigidity of the muscles will cause the affected leg to be raised from the table (Fig. XXIV).

Further examination will determine the limitation of movement and the amount of deformity. The nurse should be acquainted with the procedure, but she should not undertake the actual examination. Measurements are then taken for shortening: for real shortening measurements are taken from the anterior superior iliac spine to the internal malleolus on each side; for apparent shortening, from the umbilicus to the internal malleolus. The former determines shortening due to the destruction of bone, and the latter that which is due to the tilting of the pelvis.

After confirmation of the diagnosis by an X-ray photograph, an abduction frame complete with saddle and perineal band will be ordered (Sir Robert Jones's modification of the double Thomas's splint). Adhesive strapping extensions are necessary with this splint; the nurse should cut them to fit the limbs, stitching loops of some strong material securely at the lower end and snipping the edges of the strapping obliquely from below upwards to avoid creases.

In applying the extensions a soft bandage is first taken over the ankle and the dorsum of the foot, to prevent chafing of the skin from the lower ends of the extensions. Warming the strapping will make it adhere better; if the lower ends of the extensions be placed just above and

FIG. XXV.

Right Tuberculous Hip-Joint Disease, showing tilting of the right side of the pelvis, producing apparent shortening of the limb on the affected side.

behind the malleoli, this will ensure a direct pull on the limb, thus avoiding limitation of the dorsi-flexion of the

FIG. XXVI.

Tuberculous Hip-Joint Disease with flexion deformity of the affected hip (left).

foot, which occurs when they are placed farther forward than this. In applying the extensions to the leg of the affected side, movement of the hip joint must be avoided ;

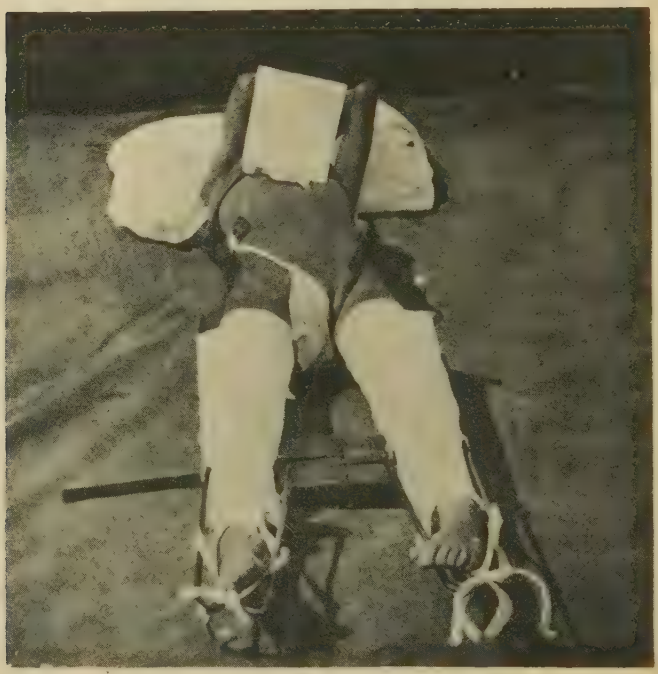

FIG. XXVII.

Application of the Jones's hip abduction splint in Right Tuberculous Hip-Joint Disease.

and in cases where the whole limb is not acutely painful and the knee can be moved without discomfort, the extensions should be applied whilst an assistant holds the limb with the knee straight.

During the application of the splint, the surgeon, or, if he prefers, the nurse in charge, steadies the leg of the affected side. The nurses in attendance should see that the saddle is in the correct position for nursing purposes (it is easier for the adjustment of the splint if the saddle is not tied to the splint at first) and that the gluteal bend of the frame corresponds to the gluteal fold of the patient. They should also bring the wings of the frame to the side of the patient's body, fasten the perineal band, tie the extensions of the good leg, bandage the leg in position, and fasten the shoulder straps. The surgeon will then correct any deformity, place the affected limb in position on the splint, fasten the extensions of this limb, and instruct the nurse in which direction she is to apply the bandage. Before putting the patient to bed, the nurse should notice the relationship of the anterior superior iliac spines to each other, the amount of lordosis present, and also the hole in which the perineal band has been fastened.

Nursing. The nurse should understand that the extension to the affected leg is to obtain correction of the pelvic tilting, and to ensure immobilization of the hip joint. The perineal band acts as a counter-pressure, keeping the patient in position on the splint by preventing the pull of the extension dragging the patient down out of position. This band exerts considerable pressure on the groin, and the skin will require attention to prevent chafing.

Before the perineal band is unfastened, means should be taken to prevent the patient slipping down, by elevating the frame by placing the horizontal bar on to a firm box or block of wood : an assistant at the side of the bed grasps the thighs with both hands, pressing upwards and towards the splint, whilst the necessary treatment is carried out. If this band is soiled, it should be wiped with a damp

soapy cloth and well dried and powdered : in replacing the perineal band, it should be pulled downwards and forwards, then taken up over the groin, and fastened into the hole that was originally used.

This treatment should be carried out as often as is necessary, to prevent soreness of the groin, which is usually the result of careless handling. If, however, a sore seems imminent, dressings should not be put between the band and the groin, the aim being to alter or distribute the pressure by some means. If a definite spot is receiving undue pressure, two small rolls of white lint of sufficient thickness to relieve the pressure may be placed one above and one below the tender part, and the band replaced over these. If the whole groin is tender and the skin inclined to break, a carefully applied plaster of Paris shield could be placed between the perineal band and the groin, to distribute the pressure over the whole surface. Should the skin, however, be too tender for this, and it appears necessary to remove the band altogether, counter-pressure can be obtained in the following way. Protect the foot and ankle by a club-foot shoe or foot plaster, and, with the knee absolutely stabilized by firm bandaging to the frame, carry a webbing strap from below the sole of the foot up each side of the leg, and fasten it to the pelvic wing ; incorporating the webbing strap in the leg bandage will prevent its slipping off the foot : in this way the extension need not be interfered with, and a perineal band can be replaced in a day or two as the groin is healed.

After any attention to the groin which has necessitated the unfastening of the perineal band, the nurse should see that the patient has not slipped out of position, by observing whether the tuberosity of the ischium is still resting in the bend of the frame. If the patient has slipped, this must be remedied and readjustment made as follows. Undo all bandages, shoulder straps, and the

extension ties of the good leg. The senior nurse will take charge of the affected leg by grasping it above the ankle and putting on slight traction. An assistant, taking hold of the patient under the axillæ, steadies the trunk, whilst a third person unfastens the extension ties of the affected leg, and pulls the frame down by taking hold of the horizontal bar until the position has been corrected, when application of the splint is completed as before described.

In washing these cases, the leg bandages should not be removed : in giving the bed-pan, the frame should be lifted by the horizontal bar and the pan placed in position from the unaffected side. A pillow placed under the shoulders will tilt the frame downwards and prevent the saddle from being soiled by excreta : in attending to the patient after the bed-pan has been used, the frame may be tilted over towards the good side, i.e. with the affected leg uppermost, but not far enough to cause movement of the body which might jar the hip joint.

The extensions should be examined daily to see that they have not slipped, and that the stitches at the junction of the loop and strapping have not given way. If either has occurred, the strapping should be renewed as follows. Having prepared the new extensions, proceed by grasping the leg at the ankle and putting traction on it whilst a assistant unfastens the bandages and ties, removes the old extensions by a firm even pull from above downwards, gently washes and dries the limb, and applies and fastens the new strapping extensions. Observation of foot movements is of great importance, the tendency of the strapping being to obstruct dorsi-flexion.

The frame must never be lifted by the extension bows, as these are not strong enough for this purpose. The 'night cries' will disappear as immobilization of the joint is complete, and the general condition of the patient will also improve. The period of fixation on the splint

will vary with the extent of the disease, an average case will probably require about six months.

After this period a plaster spica will be applied extending from the nipple line to the ankle, the patient lying in bed in this for a time, then getting upon crutches; after a longer period this spica need only extend to above the

FIG. XXVIII.

Method of turning a patient on the Jones's hip abduction splint.

knee, the leg being treated by massage and the patient taught to bend the knee, which may at first cause a little discomfort owing to the long disuse. The patient may walk in this plaster aided by two sticks at first, and later by one. A careful watch should be kept on the knee for swelling, knock knee and hyper-extension, as any of these may arise owing to the weakness of the joint structures.

Plaster of Paris will be worn until further fixation is considered unnecessary, in a child probably from two to three years. During this time the plaster will be renewed as required, the patient attending the outdoor department of a hospital and the parents instructed to examine the plaster daily for cracks or softening, and in the event of these occurring, to bring the child to the hospital without delay.

When the plaster is to be finally removed, the child will probably be admitted to hospital. The plaster is cut down and the child examined for flexional deformity and rigidity as before described. With the good leg flexed on to the abdomen, a careful note is made of the distance from the centre of the patella of the affected leg to the table on which the child lies : this observation should be made daily, and any increase of the distance reported to the surgeon. The plaster will be left off during the day and bandaged on during the night for the first week, then left off for an increasing period every few days until it is finally removed.

In cases where both hip joints are affected, a straight frame will probably be used instead of an abduction frame.

Operative treatment may be used where there is fixed deformity, after any discharging sinuses have healed, in order to correct the deformity. Either trans-trochanteric osteotomy, sub-trochanteric osteotomy, or cuneiform osteotomy may be done, and in each case the patient may be nursed on an abduction frame. In cases where both hip joints have become fixed by disease, an operation to produce a pseudo-arthrosis may be done on one of them : if there is any difference in the length of the legs, it is usually done on the longer one.

This operation consists in dividing the bone at the upper extremity of the femur, and transposing some soft tissue, such as muscle, between the bone ends, in order to avoid union and to maintain a false joint.

The patient is nursed on a hip abduction splint for the first three weeks ; the stitches are removed between the tenth and the fourteenth days, after which passive movement is ordered. In performing this movement traction is put on the leg, and the movements of flexion, adduction, and abduction are performed, once in each direction, and the limb replaced on the splint. Traction is applied during the movements to prevent telescoping of the bone ends by involuntary contraction of the muscles, which causes pain.

After removal of the frame a caliper is ordered, as long as can be worn, in order to avoid telescoping of the bone ends. As the parts heal, the patient should be encouraged to assist with the movements, which are performed daily, and ultimately to do them unassisted. As early as possible the patient should be got up and taught to balance, and to walk with the aid of two sticks. This will take some time, as a pseudo-arthrosis lacks the stability of a normal joint.

Tuberculous disease of the knee joint may begin in the epiphysis of the femur or the tibia, in the patella, or the synovial membrane of the joint. In addition to the general signs of tuberculosis, the local signs of the disease are more obvious than in the hip joint, probably because the joint structures are more superficial. The common signs are swelling, tenderness, local heat, wasting (most obvious above and below the joint), muscular spasm, limitation of movement, and pain. Deformities that may be present are flexion of the knee, outward rotation of the leg below the knee, subluxation, and knock knee.

The treatment consists in the correction of deformity and immobilization of the joint, which is frequently carried out in the Thomas's knee splint complete with leather slings for the knee and ankle. If the knee is swollen, the splint may need bowing to avoid pressure.

For the application of this splint, strapping extensions to extend to below the knee, several malleable-iron splints, a club-foot shoe, splint wool, bandages, bandage ties, safety-pins, and a bed cradle will be required, and a wooden block on which to rest the end of the splint after application. The extensions are applied first as

FIG. XXIX.
Tuberculous Knee Joint Disease (Right).

described in hip-joint disease ; the knee splint is then placed in position on the limb, with the ring of the splint well up to the top of the thigh ; a well-padded malleable-iron splint suitable for the back of the leg will be in readiness. The surgeon will then correct any deformity and bandage the knee to this splint, whilst an assistant fastens the leather sling behind the knee, and

ties the extensions at the end of the splint. The knee, well protected by wool, is guarded by short malleable-iron splints placed at each side, twisted to fit the limb ; bandage ties are carried round these three splints inside the bars of the knee splint and fastened firmly above and below the knee. The club-foot shoe is applied to the

FIG. XXX.
Application of Thomas's knee splint in Tuberculous Knee Joint Disease.

foot, and care taken to see that the sole of the foot rests in its entire length on the foot-piece of the splint. The leather sling at the ankle is adjusted, and observation made that the limb rests in the knee splint in such a way that the bars on each side correspond with the centre of the limb. A firm bandage covering all the splints completes the application.

In nursing these cases, the limb should be protected from the weight of the bedclothes by a bed cradle, the end of the splint tied either to the cradle or to the bed-end to prevent its slipping off the block on which it is resting. Care must be taken, in attending to the patient or the bed, to remember that the splint is tied here, otherwise jarring of the limb may occur. The position of the foot should be examined daily to see that the heel is resting on the foot-piece of the club-foot shoe, and the extensions kept firm, but not too tightly pulled. In moving the patient, one nurse will be required to hold the limb, so that the relationship between it and the body is not changed, by taking hold of the ring at the upper end with one hand, and the lower end of the splint with the other, avoiding any tilting up or down, and by gentle pressure bearing away from the trunk. In cases where the knee joint has been excised (see page 118), pressure in the opposite direction is necessary during the movement of the limb, and in these cases the splint should be pressed upwards towards the trunk. When rubbing the groin, slightly abducting the limb in order to reach a greater area of skin will make the work easier. In cases where the knee is very painful, the least jarring or unnecessary movement should be avoided ; this sensitiveness usually responds fairly rapidly to treatment. When all acute symptoms have subsided, the bed splint will probably be replaced by a caliper.

The caliper should be fairly long, as the extension of the knee in this depends on the ring of the caliper being against the tuberosity of the ischium. As the lower end of the caliper fits into tubing in the heel of the boot, a well-fitting boot is essential, or the patient's heel will tend to rise out of it, thus interfering with the immobilization of the knee. A short plaster, extending from just above the leg of the boot to half-way up the thigh, is sometimes

FIG. XXXI.

Method of moving patient in Thomas's knee splint.

applied. The danger of hyper-extension of the knee is thus lessened, and, if the plaster is very well fitted round the leg below the knee, it will also prevent any slight

FIG. XXXII.

Thomas's walking caliper splint applied in Tuberculous Knee Joint Disease.

rotation of the tibia which might be caused by the boot's being removed by an inexperienced person.

The boot should be worn day and night in order to maintain the extension ; this may at first cause discomfort,

due to pressure or friction, principally on the heel. Washing and rubbing will ease this, but, as the greatest care is necessary, two nurses should be employed, one holding the leg above the ankle and putting slight traction on it, whilst the second removes the boot and stocking, performs the treatment, and replaces them. If this does not give relief, cutting the leather of the boot behind the heel in the form of a cross and pressing it out away from the heel should relieve the pressure.

The caliper will be worn until recovery takes place, in a child probably from two to four years. If recovery with movement occurs, the caliper will then be replaced by a knee cage, at first allowing about five degrees of flexion, increasing this as the recovery is satisfactory. The knee should be examined daily for any return of rigidity, swelling, tenderness, and limitation of movement, and to see that full extension is possible at the joint.

In adults this length of treatment is not usually carried out, as an operation to obtain ankylosis of the joint is frequently performed, after the acute condition has subsided. This operation is not usually done on children, as it may hinder the growth of the bones by interference with the epiphyseal cartilages. The preparation for operation is as usual, the splints required will be a sterilized perforated splint and those previously described in the treatment of immobilization of the joint. A special nursing point after operation is observation of the circulation of the foot, as in cases where there has been considerable flexional deformity, the straightening of the contracted structures in the popliteal space may interfere with this.

In all movement of the patient the nurse should remember to press the splint upwards towards the trunk (see above) in order to avoid interfering with the apposition of the ends of the bones, which would be

painful. In all cases wearing a knee-splint, where there is pain at the knee-joint, the nurse will find the application of a club-foot splint will assist immobilization and lessen the pain.

Tuberculous disease of the ankle joint is fairly common, and is frequently complicated by the formation of abscesses. The disease may begin in any of the bones forming the ankle joint or in the tarsal bones, and spread to the ankle joint.

The history obtained is usually that of a subacute condition, with swelling and pain, the pain becoming worse after prolonged use, and the joint sensitive to movement and to touch. The deformity present depends on where the disease started ; in some cases the patient walks on the heel with the foot abducted, in others the heel may be elevated or a valgoid deformity may occur.

The joint may be put at rest in plaster of Paris, with the foot slightly inverted, the plaster extending to above the knee joint. As weight must not be borne on the foot, either a Thomas's walking splint and patten may be ordered, or the patient may walk on crutches wearing a patten on the opposite foot to elevate the affected foot from the ground. As the duration of this treatment will be very considerable, these cases will probably attend the outdoor department of a hospital. It will be necessary for the nurse to encourage the patient from time to time, and also to impress him with the necessity of immediate attention to any breakage of splint or plaster.

Tuberculous disease affecting the Joints of the Upper Extremity. The humero-scapular joint is less often affected by tuberculosis, and the disability and deformity due to it are not as marked as in the joints of the weight-bearing limbs. The disease usually begins at

the head of the humerus. The history given is of pain down the arm as far as the elbow, sensitiveness to touch, wasting of the muscles, and limitation of movement : this limitation is not as marked as it is at the hip joint, because the movement of the scapula on the chest wall partly compensates for the limitation of movement at the humero-scapular joint.

Either plaster of Paris or splints are used for the immobilization of this joint, the arm being maintained in abduction. Beyond the ordinary care of the plaster no special nursing measures are needed until the period of rest is over, when a lid will be cut, so that the patient may be taught to move the limb, once a day at first, lowering it again to the plaster. Any return of pain or sensitiveness would contra-indicate movement : the range of movement may be increased as the recovery is found to be satisfactory. Later an abduction plaster made to strap on over the clothes (an ' outside plaster ') may be worn, and finally a large leather pad under the arm will be substituted, which will be gradually left off until free use of the arm is permitted.

The elbow joint is the one most frequently affected by tuberculosis in the upper limb. The usual history is of pain at the joint which increases on sudden movement, tenderness and swelling, wasting of the arm muscles, the forearm being held in the position of mid-supination, and limitation of movement at the elbow joint persisting until it is held semi-flexed.

The joint is put at rest in full flexion, as this position is considered the most useful one should ankylosis result. Either a soft leather collar and cuff or plaster of Paris may be used. When the period of immobilization is over, if recovery with movement has taken place, the degree of flexion will be gradually reduced, and the nurse will now be required to exercise the most careful obser-

vation of the free movement. She should see that the patient can freely and easily carry the joint into full flexion every day, and should report the slightest deviation from this. When movement from full flexion to flexion at right angles is possible, an ordinary sling may be worn and the arm used a little, increasing the range until free movement is obtained. In adult cases the elbow is usually put up at a right angle only.

FIG. XXXIII.
Tuberculous Disease of the Wrist and Hand.

Tuberculous disease of the wrist is not common in children, and when seen in adults is usually secondary to disease elsewhere. The usual local symptoms of pain, swelling, loss of function, and deformity are present, the hand being held flexed. Rest is usually ordered on a splint maintaining the joint in dorsi-flexion.

Tuberculous Dactylitis. The small bones of the hands and feet are also affected by tuberculosis characterized by swelling and tenderness of the affected parts.

Chapter 8

DEFORMITIES OF THE VERTEBRAL COLUMN

In dealing with orthopædic cases, the nurse should bear in mind that spinal deformity may occur compensatory, to, or as the result of, other conditions that she will meet in the orthopædic wards of a hospital. No movement of the body occurs without producing some deviation of the vertebral column, the great utility of which depends on its flexibility, due to the large number of joints of the partly movable type which enter into its formation.

Three important factors bearing on the production of such deformities are :

(1) The unequal distribution of weight upon the column, such as would occur by wearing a splint to abduct the arm (see page 57) and by deformity of the head in torticollis (see page 21).

(2) Inequality at the base of the spinal column. The sacrum, the lower fixed portion of the column, is wedged in between the innominate bones, and with these forms the pelvic girdle. Any inequality of the pelvis, such as that produced by a shortened limb, would tilt the entire column towards that side, and, to bring the column back to the middle line, a lateral curvature would be produced in the lumbar region.

(3) Inequality of muscular action upon the column. Any weakness of the muscles controlling the trunk, resulting in one-sided action upon the vertebral column,

would produce deformity, with the convexity of the curve to the side of the weakened muscles. (See Infantile Paralysis, page 57.)

The vertebral column may be curved laterally (*scoliosis*), or antero-posteriorly, either as exaggerations of the normal physiological curves or independently of them. A curvature convex posteriorly is known as a *kyphosis*, one convex anteriorly as a *lordosis*.

Lateral curvature or scoliosis may be classified according to whether the condition is temporary, due to position, a *postural scoliosis*: or whether the deformity is a fixed one, *structural scoliosis*. It may also be classed according to the shape and extent of the curvature, a *total* curve, if involving the whole column; 'C-shaped', if to one side only in any part of the column; 'S-shaped', when the curvature primarily present is compensated by a second one, either above or below it; a 'triple' curve when compensated by one above and one below. For clearness of description, a curvature may also be named according to the region or regions in which it occurs: and 'right' or 'left' according to the side of the column to which the convexity of the curve lies; for example, a right dorsal, left lumbar scoliosis will be an 'S-shaped' curvature convex to the right in the dorsal region, and convex to the left in the lumbar region of the vertebral column.

The examination of cases of scoliosis includes the family history, personal history and illnesses, noting specially the infectious illnesses of childhood which may be complicated by conditions affecting the chest, such as broncho-pneumonia and pleurisy; any defects of hearing and sight; occupation. The clinical examination should take place in a warm, well-lighted room, the patient undressed and wearing only one garment, which

should come below the iliac crests and above the knees. In addition, women patients may be allowed to wear a second garment covering the front of the chest during examination of the back. It is important not to touch the patient during this examination. Some definite method of carrying out the examination should be adopted, the following being suggested :—

The patient should be requested to walk up and down, and any pecularity should be noticed. Then, when the nurse is satisfied that most of the embarrassment has disappeared and relaxation results, the patient should be asked to stand still, and the following observations should be made :

From behind the patient, note :—

(1) The head erect, flexed, or rotated
(2) The angle of the neck, equal on both sides or differing.
(3) The shoulders, whether one is higher, and either farther forward or farther backward than the other.
(4) The scapulæ, size and position ; whether one appears to be higher and farther away from the spine ; any winging of the scapula.
(5) The outline of the body, any bulging or flattening.
(6) The angle between the arm and the side of the chest, whether increased on one side, obliterated on the other.
(7) The loin angle, whether one side is increased and the other obliterated.
(8) The iliac crests, level or unequal.
(9) The outline of the hip, whether contour equal on both sides, or one side appearing higher ; whether either side seems to be carried forwards or backwards.
(10) The knees, any deformity such as knock knee.

(11) The feet, any flat foot, any valgoid deformity of the heel.

From in front of the patient make similar observations, especially of the following parts :—

(1) The face, any asymmetry.

(2) The shoulders, relative height and position of both sides.

(3) The chest, any bulging ; the level of the nipples ; the sternum and ribs, for any deformity.

(4) The anterior superior iliac spines, whether level, and the relationship of these to the umbilicus.

From the side of the patient :

(1) Any alteration in the normal physiological curves.

(2) The position of the head and shoulders, whether poking forwards.

(3) The knees, for any hyper-extension.

With the patient stooping forwards, the arms hanging loosely in front and the head down, looking along the spinal column. Note :

(1) Any deviation of the vertebral spines.

(2) Bulging at the side of the vertebral column ; this is said to correspond with rotation of the vertebræ. Determine approximately which bones correspond with the bulging.

(3) Flattening ; this will probably be on the opposite side of the column to the bulging and in the same region.

(4) The degree of stooping obtained, whether the patient can get the trunk well down or not.

(5) Any inclination of the trunk to either side.

The flexibility of the column should then be examined. In order to eliminate movement at the hip joints as far as possible, seat the patient on a stool, with the thighs fully supported, the feet on the floor. Direct the movements, flexion, forward bending, extension, backward

bending, side flexion, bending first to one side and then to the other, and rotation to each side. Examine the natural movements of walking, noticing the swing of the arms, the rotation of the trunk and pelvis. Measure the legs for real and apparent shortening (see page 103). Examine for the deformity of flexion at the hip joints

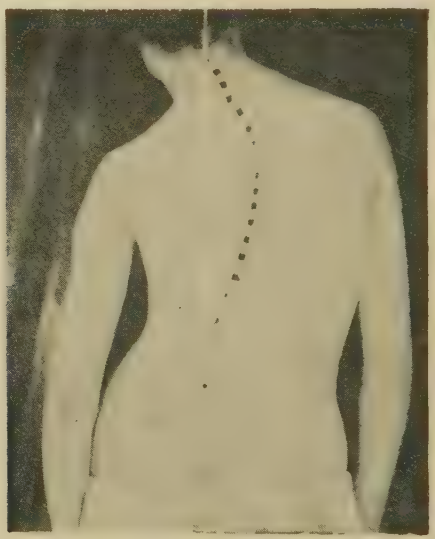

FIG. XXXIV.

Scoliosis, showing the vertebral spines marked and the plumb line in position.

(see page 103). Investigate any marked difference in muscle development.

The nurse should make detailed notes of these observations, both to report to the surgeon and for comparison from time to time of the progress made under treatment.

She will probably be required to prepare the patient for photographing, marking the skin over each vertebral spine, the outline of the crests of the ilia, and that of the inferior angle of the scapulæ with a blue pencil or with small squares of black-backed sticking plaster. She will see that the patient is given time to relax before

FIG. XXXV.

Scoliosis, the same case as Fig. XXXIV, showing the deformity seen when stooping.

being photographed, so that an accurate record of the deformity be obtained.

The treatment of scoliosis is mainly either gymnastic or by forcible correction in plaster of Paris jackets. With the former, the nurse, unless a gymnast, is little concerned, except to see that the positions of rest ordered

are adopted, and to avoid fatigue of the patient. With the latter, she is more concerned, as during confinement in a plaster jacket little gymnastic treatment will be possible. In the case of a patient wearing a plaster jacket of the Abbott type or modifications of it, windows will be cut over the flattened, concave areas, to enable these portions to be expanded by breathing. This type of jacket produces pressure over the bulging or convex areas, and elevation of one shoulder, that which was depressed in deformity, the jacket being cut low below the opposite shoulder in order to depress the originally raised one.

The nurse will be required to teach the patient to use the apical region of the lung on the side depressed in deformity and now elevated in the jacket. She should instruct the patient not to raise the arm or elevate the shoulder girdle in doing this, as, though his anxiety to please, this fault will be made at the expense of any lung expansion. In teaching expansion of the lung through the holes made in the plaster jacket over the concavities, the nurse should be content with very little at first, or the patient will try to press back into the hole in the plaster by a movement of trunk flexion within the jacket, instead of expanding the lung. Great patience is required in teaching expansion of special local areas of the chest wall.

It is easier for patients, if some exercise such as skipping or running is given first to stimulate deep breathing, and they then rest and concentrate on localization of the breathing in the parts indicated. In many cases it appears necessary to indicate the area to the patient by slight pressure of the hand, but under no circumstances should any command suggesting that the patient press back against the hand be given. If this fault is made, it will be very difficult to eradicate.

A plaster of Paris jacket may be worn for several

months ; the plaster is applied over a vest and felt fitted to the patient (see page 132). It may be necessary to change the vest, but this should not be done often, and in a well-fitting jacket is not possible. If necessary, cut the shoulder straps of the vest to be removed, putting the vest to be applied over the head, and stitching the bottom of it to the top of the soiled one, pulling the

FIG. XXXVI.

Plaster of Paris jacket of the modified Abbott type, showing the hole cut over the concave area for expansion by breathing.

soiled one down from below until the clean vest is in place.

After a variable period during which further correction by the application of plaster jackets is obtained, the surgeon will order a jacket to be cut down the centre of the front and removed for treatment by massage and exercises. Cutting a plaster jacket weakens it, and the nurse should examine it frequently for weakness and breakage ; she should also see that whenever the jacket

is re-applied after removal, it is in the correct position, and the straps with which it will now be kept in place are securely fastened.

Kyphosis may be seen in varying degrees : the sharp localized kyphosis, involving a few vertebræ, seen in

FIG. XXXVII.

Kypho-Lordosis.

Pott's disease of the spine, and due to collapse anteriorly of the bodies of the affected vertebræ : the round shoulders, an exaggeration of the normal physiological curve of the dorsal region of the column, frequently seen associated with weak chest conditions, enlarged tonsils, and adenoids, and flat foot, varying in degree from slight postural to

fixed structural deformity : and the long round back, sometimes seen in children who have not walked (see Rickets, page 78).

Lordosis or ' hollow back ' is most commonly seen as an exaggeration of the normal physiological curve in the lumbar region, and may be due to a variety of causes :

(1) The adopting of bad standing positions, such as standing erect with relaxed gluteal muscles, only contracting those of the abdominal wall and not both groups simultaneously. This is a common fault in school children.

(2) Weakness or paresis or paralysis of the muscles of one or both groups mentioned above.

(3) Occurring secondarily to other conditions, as flexional deformity of the thighs, congenital dislocation of the hip, coxa vara, and tuberculosis of the hip joint.

(4) Compensatory to kyphosis, any exaggeration of one physiological curve producing a compensatory exaggeration of another or others in order to maintain the erect position and effect balance.

(5) Spastic paralysis.

The treatment is similar to that of scoliosis, either gymnastic or by forcible correction in plaster of Paris jackets. In slight cases, when some form of brace is worn during the period of gymnastic treatment, the nurse should see that this is correctly applied and maintained.

APPENDIX

The Application of Plaster of Paris

Plaster bandages are made by rubbing fine dental plaster into the meshes of stiff gauze bandages which are cut ready and rolled in the required widths and lengths. The plaster should be fresh, dry, and free from lumps. The surface of the table on which the bandages are to be made may be protected by paper or by a board. One end of the gauze bandage is unrolled and laid flat for half a yard on the table. The plaster is sprinkled on to the gauze and a mound of plaster, placed at one end, is rubbed along the gauze with the hand flat until the meshes are filled with it. This end of the bandage is then loosely rolled up, and the next half-yard treated in the same way, until the whole bandage is completed. These bandages require to be handled carefully to avoid shaking the plaster out of them ; they should be kept in tins or other air-tight receptacles, and laid flat to preserve the plaster in them, and not put up on end. They are best when freshly made.

To apply these bandages the following will be required : Plaster bandages of the required width and number ; wool or domette bandages ; stockinette, old stockings, or other woven materials are also required, if applications are to be made to the limbs. A vest or vests and thin felt if for the body, and needles and cotton for stitching these if necessary ; a pail of warm water ; old sheets to protect the patient's clothing ; papers to protect the floor ; gowns and canvas boots for the nurses ; plaster

knives (recently sharpened) and rubber gloves may be required for the surgeon.

When the part is ready, i.e. covered with the wool, felt, or whatever is used, which should be without creases or unevenness, the patient is put into position. A plaster bandage is put into the pail of water ; it is laid flat and left until the water soaks into the bandage (unless loosely rolled, the bandages will not soak properly). When the air bubbles cease to rise, the bandage is thoroughly saturated and may then be taken out of the water. The nurse should put both hands into the pail, grasp the bandage lightly at each end, lift it gently, compress the ends, and shake but without squeezing or twisting it. Loosen the free end before handing the bandage to the person who is to apply it, and then immediately put the second bandage in to soak.

In applying a plaster bandage, lay the end over the part to be treated ; continue by unrolling with a firm, slight, even pressure, and not by pulling on the bandage. Unrolling a length and pulling it round the limb, as is sometimes done in applying an ordinary bandage, would cause tight strands. The bandage is applied quickly as it is unrolled, smoothing and fitting it with the hand as it is put on. The flexures of joints require extra strengthening strands : these may be made by putting tucks in the bandage as it is applied, or by running it backwards and forwards, or upwards and downwards, over the part once or twice between each circular turn until sufficient strength has been obtained.

Experience will teach the number of bandages that will be required for any particular part, but a pause can usually be made when the plaster begins to set. Observe whether it is setting equally or whether soft parts are found here or there, in which case more bandages will be required. Trim the edges with the plaster knife after

setting, but before the plaster is really hard ; aim at getting even, sloping edges. If the plaster comes near to a joint, as a spica of the hip might extend down the thigh towards the knee, trim it so that movement of the knee is not inconvenienced by the plaster. Where curves are necessary as near the groin in a plaster spica, cut well-rounded curves, avoiding sharp angles, or the plaster will crack.

Nursing. During the first twelve hours in the case of a small plaster, twenty-four hours for a more extensive one, the patient should, if possible, be placed near a fire, and the plaster exposed to it and to the air : failing this, the plaster should be exposed to the air and surrounded with hot-water bottles, but these should not actually touch the plaster. The plaster dries and hardens by the evaporation of water from it ; this is assisted by heat and exposure to the air.

The bed for a case in plaster (plaster bed) should have fracture boards beneath the mattress, at the lower end of the bed in the case of a leg ; but if the trunk and hips are involved, the fracture board should be complete. The part of the bed on which the plaster is to rest should be protected by a mackintosh sheet, and plenty of hot-water bottles provided, four or five in the case of a leg. When the patient is in bed, cover the unaffected parts well to keep them warm, leaving the part encased in plaster uncovered and surrounded by the bottles. It is advisable to turn the patient every two hours to expose a different part of the plaster, so as to dry it evenly, care being taken not to break the plaster. If this is not done at first, the plaster will not last long, as the water remaining in it produces softness, and soft patches will soon be noticed. A soft plaster is *not* a splint.

Patients who are walking cases may sit in a warm room

near a fire, turning about in order to dry the plaster thoroughly. In cases where the trunk is in plaster, the chest should be kept covered as far as possible in order to avoid chills ; also, when the plaster extends to the sacrum, a pillow should be placed under the back above the sacrum to relieve it from pressure ; otherwise, as much of the weight in lying is received by the sacrum, soreness would easily occur in this region. Where the edges of the plaster may cause chafing of the skin, as might occur in the case of a patient undergoing correction of some deformity of the spine, and the plaster comes well up under the axillæ, the edges of the plaster should be carefully bevelled and the skin treated by careful washing, rubbing, and powdering as often as necessary, which is generally every four hours for the first few days.

In the case of feet undergoing correction in plaster in which the patient is to be allowed to walk, the plaster should be thoroughly dried for a period of a week before weight is borne upon it.

Making a Plaster Cast

It may be necessary to take a plaster cast (*a*) to procure a record of deformity when for some reason a photograph is not suitable, or (*b*) to obtain a model from which a splint can be made when a measurement is not sufficient guide. The limb from which the cast is to be taken should be greased with olive oil, and a piece of waxed thread tied round the top of the limb : then a moderately thick mixture of plaster should be made with lukewarm water ; some of the mixture is poured on to a leaden tray covered with brown paper to prevent the plaster sticking to the tray. The greased limb is laid upon this, and the plaster mixture poured over it ; the heel should not touch the floor of the tray. The waxed thread is then laid round the limb—in the case of a leg,

down one side, along the sides of the foot, and over the tips of the toes and up on the other side—and the limb

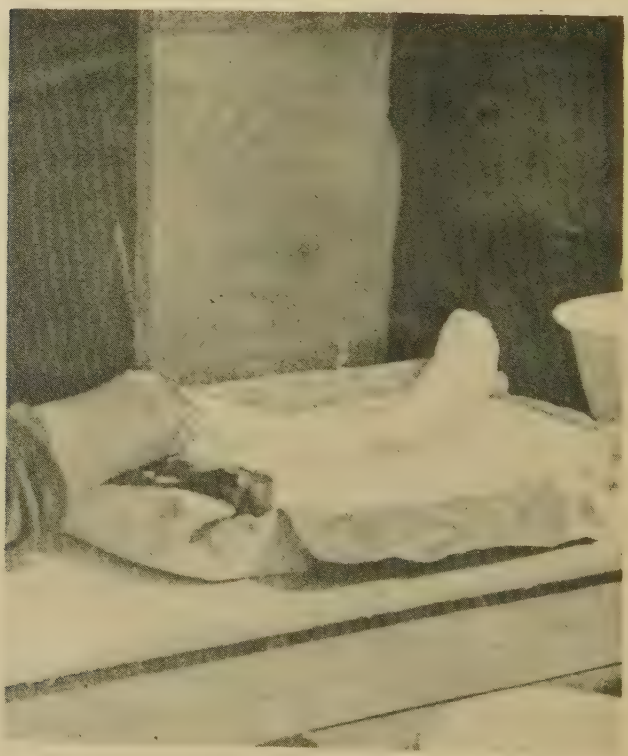

FIG. XXXVIII.

Making a plaster cast (Fig. 1): The limb on a bed of liquid plaster with waxed thread placed in position.

covered with plaster to the thickness of about two inches. The plaster should set but not harden; the string is then pulled to separate the plaster into two halves: two

chisels are placed in the crack, and the top half gently lifted off as shown in Fig. XXXIX. The plaster is dried for half a day, then soaked in a solution of soft soap, and when this is thoroughly dry, the two parts are greased with olive oil, carefully fitted together, and kept in position by a plaster bandage (see Fig. XL). Some plaster

FIG. XXXIX.

Making a plaster cast (Fig. 2): Removing the upper part of negative.

is then mixed with cold water to a fairly thick consistence, and poured into the negative, carefully avoiding bubbles. After the plaster is set, the plaster bandage is cut off, and the cast chiselled out; great care is necessary not to chip the cast. The cast should be dried for about a week and then polished with French chalk.

FIG. XL.

Making a plaster cast (Fig. 3): The negative bound together by plaster bandages, showing the filling of the cast.

FIG. XLI.

Making a plaster cast (Fig. 4): The cast in process of being chipped out.

General Rules for the Application of Splints

The padding should be adequate for the purpose for which it is intended, not thin so that the pressure of the splint will be felt through it, nor so thick that it alters the shape of the splint, and wide enough to extend beyond the edges of the splint when in position on the body. In the case of a malleable-iron splint covered with felt,

FIG. XLII.
Jones's Club-Foot Splint.

the felt should extend to the edges : splint wool applied over this should have no raw edges ; it should be laid on and not tied, as the ties may cut into the skin. After application, observations should be made that all the edges are covered with wool, as in the process of applying a splint the wool may be moved. The splints applied to correct deformity must of necessity be firm ; it may

A. B.

FIG. XLIII.

A. Thomas's Knee Splint. B. Thomas's Knock-Knee Iron.

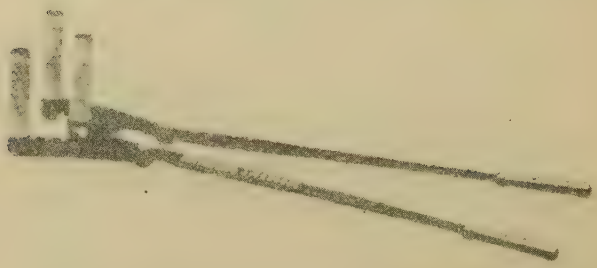

FIG. XLIV.

Thomas's Osteoclast.

not be possible to apply bandaging rules, and it should be remembered that exceptions occur in these rules in the correction of deformities. For example, in bandaging a case where flexion at the knee joint is to be corrected, a posterior knee splint being used for this purpose, instead of beginning below and working upwards, begin by a figure of eight, taken backwards and forwards across the knee until correction has been secured ; then, if wished, a bandage may be applied over this in the usual way. Again, in bandaging a foot to correct the deformity of inversion, it would be useless to apply this bandage from within outwards, as in correcting this deformity it is necessary to evert the foot by a bandage carried from without inwards.

In the readjustment of splints careful attention should be paid to the reason for the application of the splint, the effect the surgeon expects from it, and the position originally obtained by it. Splints that are bandaged on will require attention daily, and in some cases oftener, as the bandage may stretch and the splint loosen. Where straps are used, these same attentions are necessary, as breakages may occur. If for any reason readjustment of a splint retained in position by straps becomes necessary, observation should be made of the hole in which the strap was fastened, and the same hole must be used again.

Splint Sores

A splint sore is a complication that ought to be carefully avoided, as the occurrence of one may mean that treatment has to be suspended. No complaint of discomfort should be ignored, and, in the case of young children, any restlessness, fretfulness, or crying at night, ought to be investigated at once. A patient old enough to complain will probably describe pressure as a hot burning pain ;

this inevitably means a sore. On the other hand, the patient may not complain, and the first indication of soreness may be an offensive smell or a sticky discharge.

In the prevention of splint sores the usual routine treatment is followed, of washing the part with warm water and soap, rubbing thoroughly with the palm of the hand moistened with soap lather until dry, and finally dusting over with a little powder. If redness occurs, aim at distributing the pressure over a greater surface; for example, in a case being nursed on a double Thomas's splint receiving pressure over the tendon of Achilles, where the leg rests on the ankle crutch, a short malleable-iron splint that has been padded and moulded to the curve of the crutch may be inserted between the splint and the leg, or a piece of strong cardboard used in the same way may be sufficient. If this is not enough, try to relieve the pressure altogether by padding above and below the tender part in a way similar to that described in the case of a tender groin (see page 108). If a prominent part, such as a sharp kyphotic deformity of the spine, be subject to pressure caused by lying on a saddle or back rest, it may be relieved by ring pads of some firm material such as felt: the edges of the pads should be bevelled to fit the deformity, otherwise pressure will be increased at the base of the deformity, resulting in interference with the circulation, and oedema may occur. Or a hole large enough to relieve the pressure may be cut in the saddle.

Under no circumstances put extra padding over a spot receiving pressure; it may give a very temporary relief, but the pressure has been increased rather than lessened.

In a case wearing a Thomas's knee splint, pressure on the groin may be relieved by movement of the limb: pressure on the inner side of the groin, by abduction; pressure on the outer side of the hip below the anterior

superior iliac spine, by adduction ; pressure behind over the tuberosity of the ischium, by raising the leg, and, if very painful, by elevating the foot of the bed, which will relieve considerably by taking the weight of the body from the ring of the splint, and may ensure the patient having a good night.

Preparation of the Skin previous to Operation

The patient is usually given a bath, the hair washed, nails trimmed, and clean clothing put on the evening before the operation. The preparation of the area is left until a few hours before operation. It is easier and quicker if two nurses can be employed for this, one collecting the necessary articles and shaving the part, whilst the second, who is to do the preparation, ' scrubs up '. The following articles will be required : Mackintoshes ; sterile towels ; sterile swabs ; tape ; bandages ; safety-pins ; bottles of ether soap, pure ether, methylated spirit and tincture of iodine ; sterilized bowls containing an aqueous solution of biniodide of mercury 1–2000, and one of sterile water, in which a sterile nail-brush is placed ; sterilized rubber gloves, and a nurse's gown. The razor should be sterilized by soaking either in methylated spirit, pure lysol, or a solution of carbolic and methylated 1–10, for half an hour. If lysol or carbolic are employed, the razor must be wiped with sterilized wool before being used. The method of dry shaving is preferable. In shaving, the nurse should stretch the skin in order to prevent abrasions, going carefully into all folds and working over the skin from above downwards in the direction of the hairs. ' Scrubbing up ' should, if possible, be done under running water, using some liquid soap and a sterilized nail-brush. Have the arms bared to above the elbows, nails short and cuticle trimmed ; scrub the hands and

arms for ten minutes, then soak them in a solution of biniodide of mercury 1–1000 for two to three minutes, rubbing it well into the skin, especially around the nails and between the fingers ; hold the arms up to allow the water to drip off at the elbows (the arms ought never to be held down by the sides after ' scrubbing up ').

The assistant will open tins, and generally assist during the preparation.

The order is as follows :

(1) Surround the area to be prepared with sterilized towels.

(2) Wash the area for five minutes with sterile water, using a sterile swab and liquid soap, and, if necessary, the sterile nail-brush.

(3) With pure ether on a dry swab, rub until all soap and grease are removed.

(4) Wash with the solution of biniodide of mercury, rubbing it well into the skin with a sterile swab.

(5) With methylated spirit on a dry swab, rub until thoroughly dry.

(6) With tincture of iodine on a fresh dry swab, paint until the iodine is evenly distributed and the skin a light brown colour. (It is important not to cover iodine up until it is quite dry, or blisters will form.)

(7) Cover the area with a sterile towel tied on with tape and finally bandaged on, taking care to see that no part of the towel remains uncovered by the bandage.

In cases where there is much hard skin, corns, or callosities, it is advisable to soak the parts in soap and water for about an hour at a time on several days before the operation : if this is not possible, fomentations may help to soften the skin, and, if it is in a very bad condition, olive-oil compresses may be used.

Displacement of Cartilages at the Knee Joint

The articulating surfaces of the upper extremity of the tibia, where it enters into the formation of the knee joint, are deepened by the attachment of the semilunar cartilages. The external semilunar cartilage on the outer tuberosity is almost a circle; the internal semilunar cartilage on the inner tuberosity is crescent-shaped. Either of these cartilages may become displaced, the internal cartilage more frequently so, probably because the inner aspect of the joint is subject to greater strain during the movements of the knee than the outer.

Displacement is as a rule caused by wrenching the joint, usually when the knee is flexed, followed by inability to extend it. Patients will say 'they experienced pain at the joint on performing some movement; they felt something slip and could not straighten the knee'. According to the severity of the injury it will be followed by more or less effusion at the joint.

Strapping the joint may be tried, or the application of a straight posterior knee splint or a knee cage; but where the history is definite, the surgeon frequently decides to operate and remove the displaced cartilage. The patient will be prepared for operation in the usual way. The nurse should be ready to put the patient in position on the operating table, as the surgeon usually requires the knee to be flexed at right angles during this operation; she will bring the patient to the end of the operating table until the knee can hang down in this position, tying back the other leg to the frame of the table. A stool or chair of suitable height should be provided for the surgeon.

After operation an ordinary sterile dressing will be applied, and the knee bandaged to a posterior knee splint, long enough to extend half-way up the thigh and

half-way down the leg (a sterilized splint is sometimes used). Ordinary nursing management is all that is necessary until the stitches are removed, which will be about the eighth or tenth day. Afterwards the thigh muscles require strengthening ; the surgeon may order electrical stimulation of these muscles by means of the Bristow coil. At this period the nurse should instruct the patient to contract this group of muscles by voluntarily straightening the knee joint ; to ensure the maximum amount of contraction, she should teach dorsi-flexion of the foot simultaneously with extension of the knee. After a few days the surgeon may allow the patient to get up wearing either a short posterior knee splint or a firm bandage, according to the stability of the joint.

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